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E. L. Cooley.

# ANALYTICAL AND TOPICAL INDEX

TO

# THE REPORTS OF THE CHIEF OF ENGINEERS AND OFFICERS OF THE CORPS OF ENGINEERS, UNITED STATES ARMY,

## 1866-1900.

VOLUMES I AND II.—RIVER AND HARBOR WORKS.
VOLUME III.—FORTIFICATIONS, BRIDGES, LAWS, MISCELLANEOUS, AND TOPICAL INDEX.

COMPILED UNDER THE DIRECTION OF

**LIEUT. COLONEL C. W. RAYMOND,**
Corps of Engineers, U. S. Army.

BY

JOHN McCLURE.

## VOLUME I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

Transportation
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Index
1866-1900
v. 1

War Department,

Document No. 165.

Office of the Chief of Engineers.

Transportation
Library

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OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
*Washington, June 18, 1902.*

SIR: The river and harbor act approved June 13, 1902, provides that there shall be "printed one thousand copies of an Index to the Reports of the Chief of Engineers, United States Army, from eighteen hundred and sixty-six to nineteen hundred, inclusive."

This index has been prepared under the supervision of Lieut. Col. Chas. W. Raymond, Corps of Engineers, and I have the honor to submit the accompanying letter from him, dated March 22, 1902, with manuscript of the index, and to recommend that the same be printed and bound at the Government Printing Office, for use and distribution by this office, in pursuance of the above-quoted provision of law. To save expense in case further editions are required, I beg to suggest that the publication be electrotyped.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
*Brig. Gen., Chief of Engineers,*
*U. S. Army.*

HON. ELIHU ROOT,
*Secretary of War.*

[First indorsement.]

WAR DEPARTMENT,
*July 2, 1902.*

Approved.
By order of the Secretary of War.

JOHN C. SCOFIELD,
*Chief Clerk.*

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ENGINEER OFFICE, U. S. ARMY,
*New York, N. Y., March 22, 1902.*

GENERAL: I have the honor to forward herewith the manuscript of an Index to the Reports of the Chief of Engineers from 1866 to 1900, inclusive. The duty of preparing this index was assigned to my charge by the Chief of Engineers by Department letter dated June 19, 1899. Three volumes of the index, covering the period from 1866 to 1892, had been previously published, and it was intended to have an additional volume prepared covering the reports issued since 1892. The preparation of this volume was well advanced when it was decided to consolidate all the volumes into an entirely new edition in order to save space and cost and to facilitate convenient reference. This consolidation was especially desirable in view of the fact that the first two volumes are practically out of print. Accordingly, in the preparation of this new edition, the information contained in the first three volumes has been consolidated with material obtained from the later reports, and other information has been added which will be referred to hereafter.

The compilation of an index to the reports of the Chief of Engineers was first suggested by Maj. H. M. Robert, Corps of Engineers (now Brigadier-General, United States Army, retired), on January 10, 1878. The first volume, covering the reports from 1866 to 1879, inclusive, was compiled under his direction by Mr. Louis Y. Schermerhorn, assistant engineer, and by Dr. Samuel O. L. Potter, chief clerk, and was published in 1881. The second volume, covering the reports from 1880 to 1887, inclusive, was compiled under the same direction by Mr. Louis Y. Schermerhorn and by Mr. Holden B. Schermerhorn, and was published in 1889. The third volume, covering the reports from 1888 to 1892, inclusive, was compiled under my direction by the compilers of the second volume, and was published in 1895.

The first volume covered a period of 14 years and indexed 19,143 printed pages; the second, 8 years, and 21,959 pages; and the third, 5 years, and 17,031 pages. The new edition now submitted covers 8 additional years, and 34,109 additional pages. In all, the new index covers 35 years and 92,242 pages.

The plan adopted by General Robert in the preparation of the first volume of the index is essentially the one followed for the subsequent volumes and for the new edition, although some changes and additions have been made which experience has shown to be desirable.

In the new edition all the important matter contained in the annual reports of the Chief of Engineers is indexed, while the previous volumes omitted fortifications and some miscellaneous subjects not included under river and harbor improvements. The "Abstract of Laws" is a feature first introduced in the third volume.

Great care has been taken to insure accuracy. To some extent the compilations check themselves. Thus a page and volume reference is often repeated several times in different parts of the work. In compiling, comparisons and tests for proving the accuracy of the work were frequently made. Cross-referencing has been employed to a much greater extent in the new edition than in previous volumes.

Treasury Doc. No. 373, 1882, and House Doc. No. 482, Fifty-fifth Congress, second session, have been referred to for information not otherwise conveniently attainable and to check the work of the compilers.

The summary of appropriations for rivers and harbors is essentially derived from House Doc. No. 482, Fifty-fifth Congress, second session. The appropriations have, however, been brought up to the close of the fiscal year 1900. Each item in the former volumes and in the new edition was carefully compared with House Doc. No. 482, Fifty-fifth Congress, second session, and with Treasury Doc. No. 373, 1882. The correct amount to be charged to each work was thus determined. As Treasury Doc. No. 373 shows expenditures for river and harbor works, and for other Government works, for a period extending from March 4, 1789, to June 30, 1882, the summary of appropriations has been made to cover a great number of years earlier than 1866. The index does not generally refer to years earlier than 1866, but surveys and examinations prior to 1866 are also mentioned in the index, the data having been obtained from House Doc. No. 482, Fifty-fifth Congress, second session. The letter of the Chief of Engineers transmitting that document to Congress contains the following remarks:

> While the statements submitted are believed to be accurate, it is but fair to this office to say that the records respecting the examinations and surveys made in the earlier part of the century are very meagre and incomplete, but the table respecting these embraces, with two exceptions, every examination and survey under the War Department which has been directed by Congress, barring, of course, such as are still in progress. The excepted cases are the canal of Carondelet from Lake Pontchartrain via Bayou St. John to New Orleans, act February 10, 1809, and obstructions between the harbor of Gloucester and the harbor of Squam, Mass., act March 3, 1823, and it is believed that neither of these was made under the direction of the Secretary of War.

For the topical index the plan of indexing now in general use has been adopted; that is, the alphabetical arrangement of topics without regard to any other method of classification. This is a change from the plan followed in the earlier volumes. Cross-indexing and cross-referencing have been freely employed, as explained in the introduction to the subdivision.

The plan for the index of fortifications was prepared under my direction by Capt. Spencer Cosby, Corps of Engineers. This index would have been compiled by him had his services continued to be available. The summary of appropriations for the index of fortifications is made up of data obtained from Treasury Doc. 373, 1882, and partly from the annual reports of the Chief of Engineers.

The actual work of compiling all the different parts of the new index has been done under my immediate direction by Mr. John McClure. The task has been large and difficult, and has required much skill and industry. Mr. McClure deserves great credit for the faithfulness and ability with which he has conducted the work. Mr. Edward L. Stratton, jr., has rendered satisfactory service in assisting Mr. McClure, especially in the preparation of the indexes of fortifications and bridges.

Very respectfully, your obedient servant,

C. W. Raymond,
*Lieut. Col., Corps of Engineers.*

Brig. Gen. G. L. Gillespie,
*Chief of Engineers, U. S. A.*

# REFERENCES AND ABBREVIATIONS.

The figures following the black-faced figures indicate the page of the report for the year indicated by the black figures. In some instances, especially prior to 1877, the volume is indicated by lower-case i's.

References made at times to various documents will be easily understood.

The most common of the abbreviations are—

b. m. = board measure.
c. = cubic.
c. s. = Coast Survey.
f. = foot; feet.
h. = high.
l. = low; linear.
lb. = pound.
M. = 1000.
m. = mean.
p. m. = place measure.
s. = short; square.
s. m. = scow measure.
t. = tide; ton.
w. = water.
y. = yard.

The abbreviations employed for titles of officers are easy to understand.

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*Table showing what page ends each part of the annual reports of the Chief of Engineers, U. S. Army, from 1866 to 1900.*

| Year. | Part 1. | Part 2. | Part 3. | Part 4. | Part 5. | Part 6. | Part 7. | Part 8. |
|---|---|---|---|---|---|---|---|---|
| 1866 | [a] 1-58 | [a] 1-238 | [a] 1-40 | [a] 1-336 | | | | |
| 1867 | 867 | | | | | | | |
| 1868 | 1200 | | | | | | | |
| 1869 | 650 | | | | | | | |
| 1870 | 631 | | | | | | | |
| 1871 | 1030 | | | | | | | |
| 1872 | 1174 | | | | | | | |
| 1873 | 1249 | | | | | | | |
| 1874 | 897 | [b] 1-633 | | | | | | |
| 1875 | 982 | [b] 1-1245 | | | | | | |
| 1876 | 767 | [b] 1-700 | [b] 1-755 | | | | | |
| 1877 | 836 | 1455 | | | | | | |
| 1878 | 840 | 1354 | 1883 | | | | | |
| 1879 | 950 | 1890 | 2399 | | | | | |
| 1880 | 1047 | 1873 | 2556 | | | | | |
| 1881 | 1042 | 1898 | 2877 | | | | | |
| 1882 | 1068 | 1908 | 2856 | | | | | |
| 1883 | 1045 | 1960 | 2413 | | | | | |
| 1884 | 886 | 1530 | 2406 | 2903 | | | | |
| 1885 | 916 | 1660 | 2533 | 3032 | | | | |
| 1886 | 800 | 1392 | 2170 | | | | | |
| 1887 | 962 | 1735 | 2525 | 3152 | | | | |
| 1888 | 753 | 1417 | 2190 | 2941 | | | | |
| 1889 | 845 | 1533 | 2208 | 2880 | | | | |
| 1890 | 1035 | 1818 | 2884 | 3718 | | | | |
| 1891 | 975 | 1489 | 1943 | 2666 | 3395 | 3948 | | |
| 1892 | 1003 | 1958 | 2885 | 3545 | Atlas. | | | |
| 1893 | 1140 | 1798 | 2649 | 3544 | 3919 | 4404 | | |
| 1894 | 826 | 1832 | 2008 | 2696 | 3074 | 3591 | | |
| 1895 | 1020 | 1724 | 2525 | 3070 | 3615 | 3956 | 4301 | |
| 1896 | 680 | 1338 | 2060 | 2672 | 3401 | 4196 | | |
| 1897 | 1190 | 1876 | 2648 | 3503 | 3835 | 4225 | | |
| 1898 | 1074 | 1686 | 2414 | 3135 | 3458 | 3855 | | |
| 1899 | 1206 | 2045 | 2724 | 3290 | 3658 | 4002 | | |
| 1900 | 1072 | 1792 | 2306 | 2906 | 3946 | 4524 | 5006 | 5535 |

[a] Bound with the three other parts into one volume.

[b] Each part begins with page No. 1.

## Chiefs of the Corps of Engineers, U. S. Army, 1774-1902.

| Name. | Rank. | Title. | Date of appointment. |
|---|---|---|---|
| Richard Gridley | Colonel | Chief Engineer | June —, 1775 |
| Rufus Putnam | do | do | Aug. 5, 1776 |
| Lewis du Portail | do | do | July 22, 1777 |
| | Brigadier-general | do | Nov. 17, 1777 |
| | Major-general | do | Nov. 16, 1781 |
| Stephen Rochefontaine | Lieutenant-colonel | Commander, Corps of Artillerists and Engineers. | Feb. 26, 1795 |
| Henry Burbeck | do | Commander, First Regiment Corps Artillerists and Engineers. | May 7, 1798 |
| Jonathan Williams | do | Principal Engineer | July 8, 1802 |
| | do | Chief Engineer | Apr. 19, 1805 |
| | Colonel | do | Feb. 23, 1808 |
| Joseph G. Swift | do | do | July 31, 1812 |
| Walker K. Armistead | do | do | Nov. 12, 1818 |
| Alexander Macomb | do | do | June 1, 1821 |
| Charles Gratiot | do | do | May 28, 1828 |
| Joseph G. Totten | do | do | Dec. 7, 1838 |
| J. J. Abert | do | Chief, Topographical Engineer | July 7, 1838 |
| Stephen H. Long | do | do | Sept. 9, 1861 |
| Joseph G. Totten | Brigadier-general | Chief Engineer | Mar. 3, 1863 |
| Richard Delafield | do | do | Apr. 22, 1864 |
| | do | Chief of Engineers | July 13, 1866 |
| Andrew A. Humphreys | do | do | Aug. 8, 1866 |
| Horatio G. Wright | do | do | June 30, 1879 |
| John Newton | do | do | Mar. 6, 1884 |
| James C. Duane | do | do | Oct. 11, 1886 |
| Thomas L. Casey | do | do | July 6, 1888 |
| William P. Craighill | do | do | May 10, 1895 |
| John M. Wilson | do | do | Feb. 1, 1897 |
| Henry M. Robert | do | do | Apr. 30, 1901 |
| John W. Barlow | do | do | May 2, 1901 |
| George L. Gillespie | do | do | May 3, 1901 |

### *Officers on duty in the office of the Chief of Engineers, U. S. Army, 1866–1900.*

Maj. Q. A. Gillmore, 1866.
Lieut. Col. H. G. Wright, 1866–67.
Lieut. Col. J. D. Kurtz, 1866–1870.
Lieut. Col. I. C. Woodruff, 1866–1870.
Maj. W. P. Craighill, 1866–1870.
Capt. W. E. Merrill, 1866–67.
Col. J. G. Parke, 1868–1887.
Lieut. Col. T. L. Casey, 1868–1878.
Maj. J. B. Wheeler, 1870–1872.
Lieut. Col. J. G. Foster, 1866–67 and 1872–1874.
Maj. G. H. Elliot, 1874–1882.
Maj. W. J. Twining, 1877–78.
Maj. H. M. Adams, 1879–1895.
Lieut. Col. J. M. Wilson, 1882–1886.
Maj. C. W. Raymond, 1886–1888.
Maj. J. C. Post, 1887–1889.
Maj. T. Turtle, 1887–1894.
Capt. C. B. Sears, 1888–1890.
Maj. J. G. D. Knight, 1890–1895.
Col. A. Mackenzie, 1895–
Capt. G. W. Goethals, 1894–1898.
Capt. W. M. Black, 1895–1897.
Capt. J. E. Kuhn, 1896–1900.
Lieut. C. Harding, 1896.
Lieut. J. S. Sewell, 1898.
Lieut. E. Jadwin, 1897–1898.
Maj. J. L. Lusk, 1898–
Capt. E. Burr, 1898–99.
Capt. W. L. Fisk, 1899.
Capt. J. C. Sanford, 1900.
Lieut. C. S. Bromwell, 1900.
Lieut. S. Cosby, 1900.

# INDEX.

## RIVER AND HARBOR WORKS.

NOTE.—This division of the index is made up of a list of places, the names of the places being arranged in alphabetical order, where river and harbor work has been done, whether it has been work of examination, survey, or of construction.

The data relating to each work are set forth, in the order of time, generally, under titles, the most important of which are:

**Appropriations.**—The various amounts applied to the work as far as known.

**Commerce.**—Data showing the commercial importance of the place.

**Contracts.**—List of contracts of importance, with names of contractors, rates, and, especially in later years, data suggesting the magnitude of the contract.

**Engineers.**—List of engineers connected with the work, including references to the reports of the Chief of Engineers, engineers in charge, and assistants.

**Estimates.**—(See *Projects.*) Found under *Projects* in later years.

**Legal proceedings.**—The operations of the various departments of justice as far as they relate directly to the work.

**Legislation.**—Acts of Congress and of other authoritative bodies, except the acts relating to surveys, etc., under *Surveys.*

**Maps.** (See *Surveys.*)

**Obstructions.**—Artificial obstructions, such as bridges and the like, affecting the work.

**Operations.**—Brief statements of the annual work.

**Physical characteristics.**—Data relating to the tides, rainfall, physical formation, etc., of the place.

**Plans.**—(See *Projects.*) Brief outlines of important plans proposed but not adopted. Found under *Projects* in later years.

**Private work.**—Work not done by the United States.

**Projects.**—(See *Plans; Estimates.*) Outlines of the adopted plans for improvement, and references to important data relating thereto.
Estimates.
In later years, especially, important plans not adopted.

**Surveys.**—References to examinations, surveys, or to investigations ordered by Congress, or to important works of this character during the progress of a work of improvement.
Maps: At the end of *Surveys* reference is made to maps, etc., relating to the work.

**ABSECON INLET, N. J.** (See *Atlantic City Harbor; Brigantine Beach, N. J.*)

**ACADEMY CREEK, GA.** (See *Brunswick Harbor.*)

## ACCOTINK BAY AND CREEK, VA.

**Appropriations.**
1872, $5,000, **72**, 69, 688; **77**, 358; **79**, 601.

**Contracts.**
**1872.** J. H. Teemeyer, dredging, **73**, 73, 767, 768.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **71**, 76; **72**, 68, 71; **73**, 73; **74**, 83; **75**, 91; **76**, 66; **77**, 64.

ENGINEERS IN CHARGE:
Maj. W. P. Craighill, 1871–74. Reports, **71**, 620; **72**, 688, 707; **73**, 767; **74**, ii, 29.
S. T. Abert, U. S. C. E., 1875–79, **75**, ii, 110. Reports, **75**, ii, 120; **76**, 346; **77**, 358; **78**, 509; **79**, 601.

ASSISTANTS:
Capt. Chas. B. Phillips, in immediate charge, **72**, 707. Report, **72**, 710.
J. E. Weyss and G. Thompson, **72**, 707, 710.

**Estimates.** (See *Projects.*)
By Capt. Phillips, for channel by dredging, $14,081.76, **72**, 707, 711.
By Maj. Craighill, increased to $19,000, **72**, 68, 71, 670, 688.
By S. T. Abert, 1879, for completing existing project, $14,000, **79**, 601.

**Operations.**
**1872–75**. Completion of channel, by dredging, 40 f. wide, 2½ to 3 f. deep, from 2½ f. of water in the bay to a point about 200 y. within the mouth, and from that point to the village, 4 f. deep and 25 f. wide, **73**, 73, 767; **74**, 83; ii, 29; **75**, 91.

**Physical characteristics.**
Described, **72**, 711.

**Private work.**
A considerable amount expended on channel by private parties, **72**, 711. Willows planted on the banks for their preservation, **74**, ii, 29.

**Projects.** (See *Estimates.*)
By Capt. Phillips, for dredging channel, 40 f. by 5 f., from the mouth of the bay to the village of Accotink, and protecting banks by matting, **72**, 688, 707, 711.
By Maj. Craighill, for expending appropriation of 1872 of $5,000, to dredge channel 2½ f. deep, as wide as funds would permit, **72**, 688.

**Surveys.**
Under direction of Maj. Craighill, 1871, by Capt. Phillips, **71**, 76, 620; **72**, 688.
By J. E. Weyss and G. Thompson, 1872. Reports, **72**, 688, 707, 710.

## ADAMS LANDING, GRAND ISLE, VT.

**Commerce.**
About 200 tons of freight annually, and from 3,000 to 5,000 passengers, **93**, 3216.

**Engineers.**
CHIEF OF ENGINEERS. Report, **93**, 419.

ENGINEER IN CHARGE. Maj. M. B. Adams, 1892. Report, **93**, 3215.

**Physical characteristics.**
Description of, **93**, 3216.
Situated on the west shore of Grand Isle, about 4 miles north of Gordon Landing, **93**, 3216.

**Surveys.**
Examination ordered by act of July 13, 1892, made in that year by Maj. Adams (report unfavorable), **93**, 3215.

## AGATE BAY HARBOR, MINN.

**Appropriations.**

| | | |
|---|---|---|
| 1886, | $22,500, | **87**, 1952. |
| 1888, | 15,000, | **88**, 1813. |
| 1890, | 25,000, | **90**, 2284. |
| 1892, | 30,000, | **92**, 2125. |
| 1894, | 30,000, | **95**, 2531. |
| 1896, | 50,000, | **96**, 2337. |
| 1899, | 71,708, | **99**, 2609. |
| Total, | 244,208 | |

**Commerce.**
Necessity for improvement, **85**, 1955–1958.
Description of; increasing every year, large shipments of ore, **93**, 2654; **98**, 2221.
Value of cargo tonnage for fourteen years ending 1899, estimated at $40,000,000, **1900**, 3552.

## AGATE BAY HARBOR, MINN.—Continued.

**Contracts.**

**1887.** Steele Bros. & Co., 500 l. f. of breakwater construction, **87**, 1953.

**1888.** Thomas Dwyer, timber breakwater construction, $12,449, **89**, 1999.

**1891.** Campbell & McDonald, construction of 200 l. f. of breakwater, $23,400, **91**, 2487.

**1892.** Powell & Mitchell, crib breakwater construction, $42,052.50, **93**, 2656.

**1894.** McCurdy & McCurdy, riprap work, $50.20 per l. f., **95**, 2532.

**1896.** S. Meneice, riprapping pier, $12.50 and $35 per l. f. Porter Bros., riprapping embankment, $63.17 per l. f., **96**, 2338.

**1897.** S. Meneice, breakwater repairs (timber, stone, etc.), $1,138.75, **97**, 2591.

**1898.** King & Steele, breakwater extension (timber, stone, etc.), $15,300, **98**, 2222.

**1899.** Engle & Osman, 313 l. f. riprap embankment, $26,520.49, **99**, 2609.

**1900.** Powell & Mitchell, breakwater extension (cribs, stone filling, etc.), $36,135.50, **1900**, 3552.

**Engineers.**

Chief of Engineers. Reports, **85**, 296; **87**, 255; **88**, 231; **89**, 268; **90**, 241; **91**, 311; **92**, 296; **93**, 336; **94**, 308; **95**, 344; **96**, 301; **97**, 386; **98**, 378; **99**, 449; **1900**, 513.

Engineers in Charge:

Maj. J. B. Quinn, 1888–1892. Reports, **88**, 1812; **89**, 1998; **90**, 2283; **91**, 2486.

Capt. W. L. Fisk, 1892. Report, **92**, 2123.

Maj. C. J. Allen, 1885. Report, **85**, 1954, 1955.

Capt. J. B. Quinn, 1886–87. Report, **87**, 1951.

Maj. C. B. Sears, 1893—. Reports, **93**, 2654; **94**, 2011; **95**, 2530; **96**, 2336; **97**, 2588; **98**, 2220; **99**, 2608; **1900**, 3551.

Assistants:

R. Hunt. Report, **85**, 1957.

J. P. Parkinson. Report, **85**, 1954.

**Operations.**

**1886–87.** Preparations for breakwater extension, **87**, 1952.

**1887–88.** 400 l. f. of east breakwater built, **88**, 1812.

**1888–89.** Breakwater extension continued, **89**, 1998.

**1889–90.** 150 l. f. of east breakwater built, **90**, 2284.

**1890–91.** Extension of east breakwater continued, **91**, 2486.

**1891–92.** Breakwater extension continued, **92**, 2124.

**1892–94.** West pier extended 200 y., **93**, 2655; **94**, 2012.

**1894–97.** 300 l. f. riprapping done, and in progress, **95**, 2531; **96**, 2337; **97**, 2589, and east breakwater repaired, **97**, 2589.

**1897–98.** About 400 l. f. riprapping done in connection with preceding year, and extension of west pier in progress, **98**, 2220, 2221.

**1898–99.** Extension of west pier completed; embankment extension of east pier in progress, **99**, 2608.

**1899–1900.** Pier extensions in progress, **1900**, 3551.

**Physical characteristics.**

Description of, **88**, 1812; **90**, 2283; **93**, 2654; **98**, 2220.

Description of bays, **85**, 1954; **87**, 1951. Direction of winds from, 1873–1883, **85**, 1959.

A semicircular harbor of 2,000 f. radius, 27 miles east of Duluth, a large part of good navigable depth, **93**, 2654; **94**, 2011; **95**, 2530.

**Plans.**

By Maj. Allen, 1885, for constructing a breakwater in Agate Bay 1,200 f. in length, and in Burlington Bay 1,100 f. in length, with the deepening of the areas behind the breakwaters by dredging; estimated cost, $430,000, **85**, 1956.

**Projects.**

By Capt. Quinn, 1887, for constructing two breakwaters in Agate Bay, 1,000 and 900 f., respectively, extending from the easterly and westerly points of the bay; the opening between the ends of the breakwaters to be 1,340 f. and the area inclosed, 109 acres; estimated cost, $213,000, **87**, 1951. Increased in 1888 to $243,500. **88**, 1812; **89**, 1998; **90**, 311.

By Maj. Sears, 1892, for expending appropriation of that year, $30,000, in building a crib breakwater from near the west side of the entrance out into the bay in the line of prolongation of the east pier, **93**, 2655.

Maj. Sears proposed, 1899, to apply appropriation of 1899 to extension of west breakwater, and whatever remained to repair of old part of the east pier, **99**, 2608. Increase in length of easterly breakwater by 50 f. approved, 1899, **1900**, 3551.

**Surveys.**

Ordered by act of July 5, 1884, made under the direction of Maj. Allen, 1885, **85**, 1955.

Maps. **87**, 1952.

## AHNAPEE HARBOR AND RIVER, WIS. (See *Two Rivers Harbor, Wis.*)

### Appropriations.

| | | |
|---|---|---|
| 1871, | $25,000, | **75**, 198. |
| 1872, | 25,000, | **75**, 198. |
| 1875, | 25,000, | **75**, 198. |
| 1876, | 8,000, | **76**, 96. |
| 1874,[a] | 5,000, | **75**, 43, 201; **76**, ii, 362. |
| 1878, | 8,000, | **78**, 114. |
| 1879, | 7,000, | **79**, 153. |
| 1880, | 7,000, | **80**, 1911. |
| 1881, | 8,000, | **81**, 2079. |
| 1882, | 12,000, | **82**, 2139. |
| 1884, | 15,000, | **84**, 1848. |
| 1886, | 15,000, | **86**, 1662. |
| 1888, | 5,000, | **88**, 1847. |
| 1890, | 6,000, | **90**, 2339. |
| 1892, | 7,000, | **92**, 2185. |
| 1894, | 5,000, | **95**, 2619. |
| 1896, | 5,000, | **96**, 2484. |
| 1899, | 13,000, | **99**, 2752. |
| Total, | 201,000 | |

### Commerce.

Importance of the harbor to commerce as a harbor of refuge, **71**, 126. Local requirements need but limited expenditures, **73**, 200; **74**, 143.

Commercial requirements discussed by Board of Engineers, **76**, ii, 355.

Limited area of harbor inadequate for demands of commerce, **81**, 2079.

The harbor so situated with reference to interior transportation lines that it will always be used solely for local traffic, **96**, 2484.

The importance of the harbor less in 1896 than when its improvement began, **97**, 2757.

### Contracts.

**1871.** Roberts & Johnson, pile piers, **71**, 111; **76**, ii, 361.

**1872.** Joseph Rankin, pile pier (annulled), **73**, 199; **76**, ii, 362.

**1875.** Green Bay Dredge and Pile-Driver Co., crib piers, **75**, 199; **76**, ii, 346.

**1877.** Truman & Schroeder, crib superstructure, **77**, 857, 859; **78**, 1154.

**1892.** J. M. Borgman, guide piling, 225.6 f.; actual cost, $2,935.20, **93**, 2722; **94**, 2065.

### Engineers.

CHIEF OF ENGINEERS. Reports, **70**, 32, 39; **71**, 32, 37; **72**, 31; **73**, 32; **74**, 38; **75**, 42; **76**, 95; **77**, 100; **78**, 114; **79**, 153; **80**, 204; **81**, 275; **82**, 271; **83**, 280; **84**, 280; **85**, 303; **86**, 297; **87**, 262; **88**, 239; **89**, 278; **90**, 251; **91**, 321; **92**, 307; **93**, 350; **94**, 321; **95**, 359; **96**, 314; **97**, 398, 408; **98**, 390; **99**, 462; **1900**, 527.

BOARD OF ENGINEERS. Convened Oct. 13, 1875, to consider the question of improving the harbor, directed an examination to ascertain cost of proposed rock excavation, **76**, ii, 346, 354. Reconvened Dec. 15, 1875, and reported in favor of inner harbor project of Maj. Robert, **76**, ii, 354.

(Majs. Houston, Robert, Farquhar, Gillespie, and Mansfield.)

ENGINEERS IN CHARGE:

Maj. D. C. Houston, 1870–75. Reports, **71**, 125; **72**, 117; **73**, 199; **74**, 143; **76**, ii, 351.

Maj. H. M. Robert, 1875–83. Reports, **75**, 198; **76**, ii, 346; **77**, 857; **78**, 1154; (Lieut. Col.), **80**, 1910; **81**, 2077; **82**, 2139.

Capt. F. A. Hinman, 1883. Report, **83**, 1678.

Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1847; **85**, 1990; **86**, 1662.

Capt. W. L. Marshall, 1886, **86**, 290.

Capt. C. E. L. B. Davis, 1886–92. Reports, **86**, 1662; **87**, 2037; (Maj.), **88**, 1846; **89**, 2053; **90**, 2338; **91**, 2538.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2184; **93**, 2721; **94**, 2064.

Capt. C. F. Palfrey, 1895. Report, **95**, 2617.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2483; **97**, 2672, 2755; **98**, 2310.

Capt. J. G. Warren, 1899–1900. Reports, **99**, 2751; **1900**, 3674.

ASSISTANTS:

Wm. T. Casgrain. Report, **71**, 126.

Capt. J. W. Cuyler. Report, **72**, 117.

William H. Hearding. Reports, **73**, 199; **74**, 143; **75**, 198.

E. P. North, **79**, 1509. Report, **76**, ii, 346, 360.

L. Y. Schermerhorn, **78**, 1154. Reports, **79**, 1506; **80**, 1911.

C. Crossman. Report, **80**, 1910.

E. A. Cannon. Report, **1900**, 3677.

### Estimates.

By Maj. Houston, for inner harbor, $1,073,330, **71**, 125, 127. For outer harbor, $367,568, **71**, 126, 128; $370,000, **74**, 143. For local requirements, $100,000, **73**, 200; **74**, 143.

By Maj. Robert, 1875, for completion of modified project, $95,000; **76**, ii, 346, 359. Detailed estimates for rock work, **79**, 1509.

### Legal proceedings.

Injunction threatened by claimant of site of rock blasting, **77**, 857. Site deeded to village, **77**, 857; but not recorded, **78**, 1154.

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[a] Allotted from appropriation for Two Rivers Harbor, Wis.

## AHNAPEE HARBOR AND RIVER, WIS.—Continued.

**Legislation.**

By State of Wisconsin, authorizing tax for improvement, **71**, 127.

**Operations.**[a]

**1871-72.** North pile pier commenced by contract June 30, **71**, 111; **72**, 117; **76**, ii, 361. Difficulties, **72**, 117.

**1872-73.** South pier commenced by hired labor, **73**, 199. Extended, **74**, 143. Dredge and scows built, **73**, 200; **74**, 143, **75**, 198.

**1873-74.** Pile driver built, **74**, 143.

**1874-75.** Dredging from 50-f. channel and bayou. Filling of south pier, **75**, 198.

**1875-76.** Seven cribs sunk, south pier refilled, rock drilled, blasted, and dredged, for experimental purposes, **76**, ii, 346. Work under Maj. Robert's project for inner harbor commenced by E. P. North, 1876. Details of blasting, **76**, ii, 347. Results, will require to be redrilled and blasted, **79**, 1509.

**1876-77.** Dredging of blasted rock, **77**, 857.

**1877-78.** Dredging of rock, 100 cords placed in piers; 1,100 f. plank walk laid, **78**, 114. Superstructure built over 7 cribs sunk in 1875, **78**, 1154. Drilling and blasting recommenced, **78**, 114, 1154.

**1878-79.** Drilling and blasting, **79**, 153, 1505. Details and cost, **79**, 1508. Condition of harbor, **79**, 1511.

**1879-80.** 4,795 c. y. rock removed by U. S. dredge; 620 f. pile pier revetted; cost of rock removal by dredge, cost of pile pier revetment, **80**, 1911, 1914.

**1880-81.** 10,980 c. y. rock removed by drilling and blasting and use of U. S. dredge; 6,400 c. y. rock removed to adjacent harbors for pier filling; details of rock removal, **81**, 276, 2077.

**1881-82.** Two cribs built with timber from U. S. reservation at Sturgeon Bay, **82**, 2139.

**1882-83.** 23,587 c. y. sand and mud and 4,820 c. y. rock removed by hired labor and use of U. S. dredge; 12 cribs built and 9 sunk in extension of piers; timber used for crib building from U. S. reservation, and rock for crib filling from excavation of interior harbor; cost of crib construction and rock removal, **83**, 280, 1680, 1689. Removal of 1,198,644 f. B. M. timber from U. S. reservation at Sturgeon Bay, **83**, 1679.

**1884-85.** 100 l. f. pier extension; 6,413 c. y. rock and 4,478 c. y. sand removed by hired labor and use of U. S. dredge; 450 l. f. of superstructure built. Cost of rock removal and pier construction; saving in cost of work by use of timber from U. S. reservation, and rock for crib filling from harbor excavation, **85**, 303, 1990, 1991.

**1885-86.** Removal of 20 c. y. rock from inner harbor by U. S. dredge, **86**, 1662.

**1886-88.** No operations from proviso in act of Aug. 5, 1886, that wharfage over the U. S. piers must be made free, **87**, 2038; **88**, 1846.

**1888-89.** Operations resumed, it being recommended that the proviso as to free wharfage be omitted from future appropriations. 3,496 c. y. rock and 19,965 c. y. sand removed from the channel; crib in south pier reset; 250 l. f. south pier superstructure built; 150 l. f. north pier extension completed; work done by hired labor, **89**, 2054.

**1889-90.** North pier extended 50 f., and 4,147 c. y. rock and 5,330 c. y. sand removed by blasting and dredging; work done by hired labor, **90**, 2338.

**1890-91.** 200 l. f. of north pier superstructure built by hired labor; minor repairs to south pier, **91**, 2539.

**1891-92.** 352 l. f. of north pile pier provided with sheet piling; 652 c. y. rock and 28,205 c. y. sand and gravel dredged from the channel; all operations by hired labor, **92**, 2185.

**1892-93.** South pier repaired and 2,140 c. y. dredged, **93**, 2721.

**1893-94.** About 112 l. f. of guide piling constructed. Minor repairs made to north pier, **94**, 2064.

**1894-95.** 362 l. f. south pier rebuilt, **95**, 2617, 2618.

**1895-96.** 9,750 c. y. dredged, **96**, 2484.

**1896-97.** Dredging plant repaired, **97**, 2672.

**1897-98.** 12,543 c. y. dredged and piers repaired, **98**, 2310.

**1898-99.** 18,548 c. y. dredged; rock excavating plant built, **99**, 2752.

**1899-1900.** 9,765 c. y. rock excavated (photographs), **1900**, 3675.

**Physical characteristics.**

Of sand spit at pier foot, **74**, 143.

Description of, **97**, 2756.

The harbor situated at the mouth of Wolf or Ahnapee River, on the Lake Michigan or eastern side of the peninsula projecting between Green Bay and Lake Michigan, and is about 120 miles northward of Milwaukee, **97**, 2757.

**Plans.**

W. T. Casgrain, for inner harbor, estimated cost, $1,073,330; considered too costly, **71**, 127.

Maj. Houston, for outer harbor, **71**, 125.

The two plans compared, **71**, 126.

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[a] History of operations, **74**, 143; **76**, ii, 354; **86**, 1662. History of work to 1875, by Maj. Houston, **76**, ii, 361.

## AHNAPEE HARBOR AND RIVER, WIS.—Continued.

### Private work.

By citizens, construction of bridge piers, also a straight cut through bar at river mouth, etc., **71**, 126, 127.

Temporary pier built by citizens inside Government piers, to be removed, when so required, at their expense, **74**, 143; **75**, 198.

Neglect of local authorities to preserve improvements made, **82**, 272, 2139, 2140.

Improper use of United States piers by local interests, **85**, 1990; **87**, 2038.

### Projects.

The original project of 1870, by Maj. Houston, proposed the formation by pier extension and dredging, of an outer harbor covering the mouth of Ahnapee River; estimated cost, $370,000, **71**, 125; **72**, 118; **76**, ii, 351.

In 1873 the project was modified to provide for the formation of a small harbor at the mouth of the river, which might be subsequently utilized should the larger outer harbor ever be required; estimated cost, $100,000, **73**, 200; **74**, 143; **76**, ii, 351.

In 1875 Maj. Robert proposed the extension of the piers, provided for under the project of 1873, to the 18-f. curve in Lake Michigan, and the formation of an inner harbor 100 f. wide and 12 f. deep, extending from the highway bridge to the mouth of the river, at an estimated cost, in addition to $75,000 already appropriated, of $95,000, **76**, ii, 346–359; increased by Board of Engineers, **76**, ii, 346. Details discussed with estimates in light of experience, **79**, 1509.

In 1884 the project was modified by increasing the width of entrance to the piers to 200 f., **85**, 1990.

In 1891 the estimate of 1875 was increased by $10,000, and $9,000 was estimated as required for completion of the existing project, **91**, 2539. Estimate for completion increased in 1892 to $12,000, **92**, 2185.

By Capt. Zinn, 1896, for excavating and dredging 13-f. channel 50 f. wide up the river for 800 f. beyond the head of the existing channel; estimated cost, $11,594, **97**, 2760; **99**, 2751.

### Secretary of War.

Approves report of Board of Engineers, **76**, ii, 354.

### Surveys.

Directed, act of July 11, 1870, **71**, 32. Made by W. T. Casgrain under direction of Maj. Houston, **72**, 125.

By order of Board of Engineers, **76**, ii, 346.

Survey ordered by act of June 3, 1896, made in the same year by Capt. Zinn (see *Projects*), **97**, 2755.

Maps of work. **76**, ii, 350; **79**, 1510; **88**, 1846.

Photographs. (See *Operations, 1899–1900.*)

## ALABAMA RIVER ALA. (See *Hiwassee and Tennessee Rivers.*)

### Appropriations.

| | | | |
|---|---|---|---|
| 1878, | $25,000, | **78**, | 81. |
| 1879, | 30,000, | **79**, | 104. |
| 1880, | 25,000, | **80**, | 1083. |
| 1881, | 20,000, | **81**, | 1200. |
| 1882, | 20,000, | **83**, | 1009. |
| 1884, | 10,000, | **85**, | 1307. |
| 1886, | 15,000, | **86**, | 1172. |
| 1888, | 20,000, | **88**, | 1188. |
| 1890, | 20,000, | **90**, | 1657. |
| 1892, | 70,000, | **92**, | 1421. |
| 1894, | 50,000, | **95**, | 1669. |
| 1896, | 40,000, | **96**, | 1406. |
| 1899, | 50,000, | **99**, | 1681. |
| Total, | 395,000 | | |

### Commerce.

Restrictions to commerce, **76**, 507; **79**, 827.

Advantages arising from improvement, **76**, 498, 507; **79**, 829; **80**, 1085; **81**, 1203; **83**, 1010; **85**, 1306; **86**, 1171.

Present and prospective demands of commerce, **91**, 1765.

Commerce, 1895, valued at $4,813,000 per year, **95**, 1669.

### Contracts.

**1900.** M. A. Sweeney Shipyard and Foundry Co., dipper dredge, $13,440, **1900**, 2136.

### Engineers.

Chief of Engineers. Reports, **76**, 74; **78**, 81; **79**, 104; **80**, 137; **81**, 186; **82**, 182; **83**, 194; **84**, 203; **85**, 203; **86**, 201; **87**, 170; **88**, 158; **89**, 183; **90**, 166; **91**, 204, 211; **92**, 200; **93**, 222; **94**, 205; **95**, 231; **96**, 205; **97**, 260; **98**, 256; **99**, 299; **1900**, 340.

Engineers in Charge.

Capt. A. N. Damrell, 1876–85. Reports, **76**, 498; **78**, 594; **79**, 827; (Maj.) **80** 1083; **81**, 1200; **82**, 1278; **83**, 1008; **84**, 1200.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1306; **86**, 1171; **87**, 1288; **88**, 1187.

Capt. P. M. Price, 1889–93. Reports, **89**, 1400; **90**, 1654; **91**, 1738; **92**, 1418; **93**, 1718.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1277; **95**, 1663; **96**, 1396; **97**, 1633; **98**, 1405.

Capt. C. A. F. Flagler, 1899. Reports, **99**, 1676; **1900**, 2132.

## ALABAMA RIVER, ALA.—Continued.

ASSISTANTS.
Gavin B. Yuille. Report, **76**, 499.
C. B. Percy. Reports, **89**, 1401; **90**, 1655; **91**, 1739, 1764, 1766; **92**, 1419.

**Operations.**

**1878–79.** Snag-boat purchased, by which 320 logs were removed; dam built at "Cut-off," **79**, 104, 827, 829.

**1879–80.** Completion of dam across "Cut-off;" 3 chutes closed at Haynes Island; partial closure of chutes at Erwins Bar, Hobbs Bar, and Yellow Jack Bar, and the removal of 490 snags from the river, **80**, 1084.

**1880–81.** Completion of improvement at following bars: Gardners Island, Coxs Bar, Hadnots Bar, Three Chutes, and bar below Cut-off, **81**, 186, 1201.

**1881–82.** Repair of dam at Cut-off and Hobbs Island; completion of dam at Gardners Island, **82**, 1279.

**1883–84.** Operations limited to removal of overhanging trees and snags, **84**, 1201.

**1884–85.** Removal of snags and logs, **85**, 1306.

**1885–86.** Removal of snags and logs and closing low-water chute by brush dam near Gardners Island, **86**, 1171.

**1886–87.** Removal of obstructions between mouths of the Alabama and Tallapoosa rivers, **87**, 1288.

**1887–88.** 1,333 logs and snags removed from the channel and 533 overhanging trees cut from the banks, **88**, 1188.

**1888–89.** 2,200 logs and snags and one wreck removed from the channel; 4,730 trees and stumps removed from the banks, **89**, 1401.

**1889–90.** 1,706 logs and snags removed from the channel; 4,111 trees and stumps removed from the banks; repairs to snagging plant, **90**, 1656.

**1890–91.** Snagging operations continued, **91**, 1739.

**1891–92.** 962 snags, 25 bowlders, 1,550 c. y. gravel removed from the channel; 2,710 trees cleared from banks, and 181 l. f. of rock and brush jetty built, **92**, 1420.

**1892–93.** About 3,000 obstructions removed, 4,281 l. f. dams built, and 75 l. f. rebuilt; 335 s. y. shore protection constructed, and 230 bowlders removed from the banks and stream, **93**, 1721.

**1893–94.** 80 l. f. old dams torn out, 6,666 l. f. dam construction in progress, 943 s. y. shore protection constructed, 1,444 l. f. bar protection constructed, and 1,881 obstructions removed, **94**, 1282.

**1894–95.** 4,530 l. f. dikes under repair and construction, 4,085 s. y. shore protection under construction and repair, and about 800 obstructions removed, **95**, 1667.

**1895–96.** About 1,000 obstructions and part of a wreck removed; dike construction and repair in progress, **96**, 1400, 1401.

**1896–97.** 2,498 obstructions and wreck of flatboat removed, 2,205 l. f. dike built, and repairs made to Government craft, **97**, 1636, 1637.

**1897–98.** About 3,000 obstructions removed, **98**, 1408.

**1898–99.** About 670 snags and other obstructions removed, **99**, 1678.

**1899–1900.** Over 3,000 snags and other obstructions removed, **1900**, 2133.

**Physical characteristics.**

General, **76**, 500, 501. List of bars, shoals, and reefs in Alabama River, **76**, 503. Tide statistics, **79**, 829.

General widths and depths, **82**, 1279.

Character of the banks and river bed, **79**, 827; **89**, 1400; **90**, 1654; **91**, 1761, 1762.

Condition of the channel at the various bars, islands, and shoals, from the mouth to the junction of the Coosa and Tallapoosa rivers, **91**, 1768.

Detailed description of, **96**, 1402–1405; **97**, 1633; **98**, 1408.

**Plans.**

Gavin B. Yuille, for removal of snags, logs, etc., and construction of dams and jetties, to make a channel 150 f. wide and 6 f. deep at m. l. w., $459,773.25, **76**, 498, 502, 507.

Capt. Damrell, for annual operations of snag boat, $10,000 per year, **79**, 829.

**Projects.**

By Capt. Damrell, 1876, for the improvement of the river from its mouth, 50 miles above Mobile, to Wetumpka, Ala., a distance of 323 miles; by the removal of logs and snags, and by the construction of wing dams and jetties, so as to give a channel 200 f. wide and 4 f. deep at m. l. w., at an estimated cost of $229,741, **76**, 498, 507; **85**, 203.

In 1891, the project of 1876 having been practically completed at a cost of $172,000, Capt. Price proposed increasing the channel depth to 6 f., at an estimated cost of $386,251, **91**, 1740, 1765.

**Surveys.**

By Gavin B. Yuille, 1875, **76**, 74. Report, **76**, 499.

Examination for a 6-f. channel from the mouth to Wetumpka, ordered by act of Sept. 19, 1890, made, 1890, under direction of Capt. Price, **91**, 1761.

Minor surveys, **94**, 1282; **95**, 1667; **96**, 1402; **97**, 1638.

MAPS. **84**, 1202; **94**, 1280; **95**, 1668.

## ALABAMA RIVER TO HIWASSEE RIVER, TENN., CANAL.

(See *Hiwassee River, Tenn.*)

## ALAFIA RIVER, FLA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 174.

ENGINEER IN CHARGE. Capt. W. M. Black. Report, **89**, 1357.

ASSISTANT. D. B. Dunn. Report, **89**, 1358.

**Physical characteristics.**

Description of, **89**, 1357.

**Plans.**

By Capt. Black, 1889, for improvement of the river by carrying the channel depth at the mouth, 15 f. at low water, over the shoals as far as Peru, by dredging, assisted by light wing dams; estimated cost, $10,000, **89**, 1358.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Black, **89**, 1357.

## ALAMEDA CREEK, CAL.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 334.

ENGINEER IN CHARGE. Lt. Col. G. H. Mendell. Report, **84**, 2207.

ASSISTANT. Lt. C. F. Palfrey. Report, **84**, 2207.

**Survey.**

Ordered by act of Aug. 2, 1882, made under direction of Col. Mendell, 1882, (report unfavorable) **84**, 2207.

## ALAQUA BAYOU, FLA., bar at mouth of.

**Commerce.**

In 1893 it was considered unimportant, **93**, 1739.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 228.

ENGINEERS IN CHARGE. Capt. P. M. Price, 1893. Report, **93**, 1738.

ASSISTANT. J. E. Turtle. Report, **93**, 1739.

**Physical characteristics.**

Description, **93**, 1739.

The bayou is an indentation of the north shore of Choctawhatchee Bay, about 60 miles east of Pensacola, **93**, 1739.

**Survey.**

Examination of the bar at the mouth of the bayou at its entrance into Choctawhatchee Bay ordered by act of July 13, 1892, made under direction of Capt. Price, 1892, (report unfavorable) **93**, 1739.

## ALBANY, ABOVE AND BELOW. (See *Hudson River, N. Y.*)

## ALBEMARLE AND CHESAPEAKE CANAL. (See *Norfolk Harbor Waterways.*)

## ALBEMARLE SOUND. (See *Norfolk Harbor Waterways; Norfolk, Va.; Norfolk Harbor to the Atlantic.*)

## ALBEMARLE SOUND AND ATLANTIC OCEAN, communication between.[a] (See *Croatan Sound, N. C.*)

**Appropriations.**

1843, $15,000, act, Mar. 1.
1852, 50,000, act, Aug. 30.

Total, 65,000

**Surveys.**

Report, Feb. 12, 1829 (estimate, $327,734.10).

Authorized Mar. 1, 1843, the expenses to be paid from an appropriation of $15,000 for surveys relating to the military defenses of the frontier, inland, and Atlantic, estimate, $2,083,037.77.[a]

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[a] H. Doc. No. 482, 55th Cong., 2d sess.

## ALEXANDRIA, LA., Falls at. (See *Red River.*)

## ALEXANDRIA, VA. (See *Hunting Creek, and Potomac River.*)

## ALEXANDRIA BAY, N. Y., Harbor at.

**Commerce.**

The place a popular summer resort, and the commerce consists of a large passenger traffic and transportation of supplies for the hotels, etc., during the summer, **97**, 3312.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 482.

ENGINEER IN CHARGE. Maj. W. S. Stanton, 1897. Report, **97**, 3312.

**Physical characteristics.**

Description of, **97**, 3312.

Alexandria Bay is a village on the banks of the St. Lawrence, about 28 miles below Lake Ontario, containing about 1,200 inhabitants, **97**, 3312.

**Survey.**

Examination ordered by act of June 3, 1896, made, 1897, by Maj. Stanton (report unfavorable), **97**, 3312.

## ALEXANDRIA CANAL, D. C. AND VA.[a] *Canal to Washington.*

**Appropriations.**

1837, $300,000, act Mar. 3.[a]

## ALEXANDRIA HARBOR, MO. (See *Mississippi River from Des Moines Rapids to the mouth of the Illinois River.*)

## ALGONAC, MICH. (See *St. Clair River, Mich.*)

## ALLEGHENY RIVER, PA. AND N. Y.[b] (See *Kiskiminitas River; Pittsburg, Pa.*)

| Part. | Appropriations. |
|---|---|
| A.—Allegheny River (including also data continued separately under Parts B and C) | $352,500 |
| B.—Allegheny River | 40,000 |
| C.—Allegheny River, construction of locks and dams | 740,000 |
| Total | 1,132,500 |

### Part A.—Allegheny River, Pa.

**Appropriations.**

1879, $10,000, **79**, 144.
1880, 20,000, **80**, 1767.
1881, 25,000, **81**, 1947.
1882, 15,000, **82**, 1934.
1884, 35,000, **85**, 1818.
1886, 30,000, **86**, 1545.
37,500,[c] **86**, 1546.
1888, 25,000, **88**, 1680.
35,000,[c] **88**, 1683.
1890, 20,000, **90**, 2195.
35,000,[c] **90**, 2198.
1892, 25,000, **92**, 1995.
40,000,[c] **92**, 1996.

Total, 352,500

**Commerce.**

Of river above Pittsburg, confined to lumber and oil; requirements for, **76**, ii, 147, 151, 152; **79**, 1374.

Oil, amount of, brought to Pittsburg, **76**, ii, 152; **79**, 1374. Transportation of, by pipes, **76**, ii, 148, 151; **79**, 1374. Cost of, **76**, ii, 151.

Improvement of river, above Pittsburg, not justified, **76**, ii, 147, 148.

Injury to commerce by bridges, **79**, 1372, 1375.

Necessity for improvement of river at Pittsburg, **76**, ii, 149; **80**, 1767; **84**, 1702; **86**, 1545.

**Contracts.**

**1889.** J. J. Shipman, dike construction, $13,784, **89**, 1886.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 90; **78**, 109; **79**, 144, 147; **80**, 193, 195; **81**, 261; **82**, 256; **83**, 264; **84**, 262; **85**, 283; **86**, 273; **87**, 239; **88**, 216; **89**, 251, 252; **90**, 227; **91**, 292; **92**, 280.

ENGINEERS IN CHARGE.

Maj. W. E. Merrill, 1876–91. **76**, 90. Reports, **76**, ii, 147; **79**, 1371; (Lt. Col.), **80**, 1764, 1767; **81**, 1945; **82**, 1931;

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[a] H. Doc. 482, 55th Cong., 2d sess.

[b] To French Creek (Franklin): Survey.—Report, May 20, 1832. To Olean: Survey.—Report, Mar. 17, 1838; estimate, $877,466. (H. Doc. No. 482, 55th Cong., 2d sess.)

[c] For dam at Herrs Island, **86**, 1546; **87**, 1812; **92**, 1996.

## ALLEGHENY RIVER, PA. AND N. Y.—Continued.

### Part A.—Allegheny River, Pa.—Continued.

**83,** 1550; **84,** 1702; **85,** 1818; **86,** 1544; **87,** 1810, 1811; **88,** 1680, 1682; **89,** 1885, 1887; **90,** 2194, 2198; **91,** 2363, 2366.

Maj. A. Stickney, 1892–93. Reports, **92,** 1992, 1996.

ASSISTANTS:

Lt. F. A. Mahan. Report, **76,** ii, 149.

I. V. Hoag, **76,** ii, 147; **81,** 1945. Reports, **82,** 1931; **83,** 1551.

T. P. Roberts. Reports, **79,** 1372; **80,** 1765, 1768.

J. B. Dougherty, **80,** 1767.

J. W. Arras. Reports, **88,** 1681; **89,** 1886, 1888; **90,** 2194; **91,** 2364, 2367; **92,** 1992.

**Legal Proceedings.** (See *Projects*, 2d par.)

Work at Cornplanter Islands stopped by injunction, **90,** 2195; removal of injunction secured by modification of plan, **91,** 2364.

Commencement of operations on Herrs Island Dam delayed by suit brought by riparian owners, **92,** 1996.

**Legislation.**

Required by State of Pennsylvania giving U. S. jurisdiction over land required for lock and dam at Pittsburg, **86,** 274, 1545; **87,** 1812.

**Obstructions.** (See *Commerce.*)

List of obstructions, **79,** 1377.

**Operations.**

**1879–80.** Construction of dams at Six-Mile Island, Nicholsons Rapids, and Garrisons Ripple. Dredging at mouth of river and purchase of snag boat, **80,** 1765.

**1880–81.** Repairs to dams at Six-Mile Island and Nicholsons Rapids. Removal of snags and rocks, **81,** 1945.

**1881–82.** Repairs to dams at Six-Mile Island and Nicholsons Rapids. Removal of rocks and snags, **82,** 1931.

**1882–83.** Removal of 301 snags and 28,513 c. y. rock, **83,** 1551.

**1884–85.** Repairs to dam at Nicholsons Rapids. Removal of 70,649 c. y. of rock, 3,555 c. y. gravel, and 848 snags, **85,** 1819.

**1886–87.** Removal of rock from river channel and preparation for construction of inclined plane at Corydon dam, **87,** 1810.

**1887–88.** Dam at Corydon partially rebuilt, repairs to Six Mile and Nicholsons dams, and 540 tons rock removed from river bed, **88,** 1680.

**1889–90.** Repairs to dams at Six Mile and Nicholsons islands; 1,739 l. f. of timber and stone dike completed under contract at Red Bank, **90,** 2194.

**1890–91.** Dam at Cornplanter Islands completed; 50 l. f. of dam at Pithole built; 236 c. y. rock used in repair of dike at Red Bank, **91,** 2363. Site prepared for lock-keeper's house at Herrs Island, **91,** 2366.

**1891–92.** Dams at Hickory and Pithole completed; repairs to dike at Red Bank and dam at Nicholsons Island; 500 c. y. rock removed from bar at foot of Pithole Ripple; 621 c. y. rock and 11 snags removed between Kittanning and Pittsburg, **92,** 1993, 1994.

**Physical characteristics.**

Fall of river from Freesport to mouth, **76,** ii, 147. Tributaries, **76,** ii, 150. River consists of alternate pools and shoals, **76,** ii, 150. Conformation of bottom, **76,** ii, 147, 152. General description, **79,** 1373; **80,** 1767, 1769. Floods, slope, **80,** 1769.

**Plans.** (See *Projects.*)

By Maj. Merrill, from mouth to Freeport, 30 miles, slack-water navigation, consisting of 5 dams and locks, with an average lift of 11 f.; locks 200 f. by 50 f.; estimated cost, $765, 132, **76,** ii, 149.

By Lt. Col. Merrill, 1876, for the improvement of the river at Pittsburg by the construction of a lock and dam at Garrisons Ripple, at an estimated cost of $153,000, **76,** ii, 149; **80,** 1767; **82,** 1933. Probability that further consideration will increase estimate, **86,** 1545. Estimated cost, $400,000, **87,** 1812.

**Private (Corporate) Work.** (See *Projects*, 2d par.)

Pipe lines laid by natural-gas companies across the bed of the river, **85,** 1920.

**Projects.** (See *Plans.*)

By Maj. Merrill, for improvement of river, from mouth to upper limits of city of Pittsburg, 8.3 miles, to a minimum depth of 6 f., by lock, with movable dam; navigable pass of dam, 200 f. wide; lock, 200 f. by 50 f. by 6 f.; approximate estimate, $269,564, **76,** ii, 148, 149.

Maj. Merrill, 1876, proposed the improvement of Garrisons Ripple at the head of Herrs Island, about 2 miles above the confluence of the Allegheny and Monongahela rivers, with a lock and fixed dam at the head of the Allegheny arm of the pool formed by the Davis Island dam; estimated cost, $153,000, **76,** ii, 148; **80,** 1766; **86,** 1545. In 1891 the authorities of Allegheny City gave the necessary land on the right bank on condition that the dam be made a movable one. The plans for the work were accordingly changed, increasing the estimated cost to $600,000, **91,** 2366.

By Maj. Merrill, 1879, for the temporary improvement of the river by rock removal

## ALLEGHENY RIVER, PA. AND N. Y.—Continued.

### Part A.—Allegheny River, Pa.—Continued.

(estimate, $51,425), construction of wing dams, closing low water chutes behind islands, erection of a log chute in the dam at Corydon Island, and repairs to dams at Nicholsons and Six-Mile islands, **79**, 144, 1371, 1376; **86**, 273; **88**, 1681.

**Surveys.**

In vicinity of Pittsburg, 1875, **76**, 90, ii, 147, 149, and examination from Pittsburg to Freeport, **76**, ii, 147, 149. From Pittsburg to French Creek, **78**, 109; **79**, 1371.

By T. P. Roberts, 1879, from French Creek, Pa., to Olean, N. Y., **80**, 1767.

Survey for location of Herrs Island lock and dam, made, 1889, under direction of Lt. Col. Merrill, **89**, 1888.

### Part B.—Allegheny River, Pa.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1894, | $12,500, | **95**, | 2407. |
| 1896, | 12,500, | **96**, | 2198. |
| 1899, | 15,000, | **99**, | 2410. |
| Total, | 40,000 | | |

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 315, 319; **94**, 292; **95**, 326, 328; **96**, 281, 284; **97**, 362; **98**, 375, 377, 378; **99**, 422, 423; **1900**, 485.

ENGINEERS IN CHARGE:

Lt. Col. A. Stickney, 1892–93. Reports, **93**, 2498, 2535, 2538, 2540.

Capt. R. L. Hoxie, 1894–96. Reports, **94**, 1913; (Maj.), **95**, 2406; **96**, 2196, 2212.

Maj. C. F. Powell, 1897——. Reports, **97**, 2424; **98**, 2202, 2211; **99**, 2410, 2411; **1900**, 3263.

ASSISTANTS:

Lt. H. F. Hodges. Reports, **93**, 2537, 2540, 2542.

J. W. Arras. Reports, **93**, 2498; **94**, 1914; **95**, 2406; **96**, 2197; **97**, 2425; **98**, 2202.

G. M. Lehman. Report, **99**, 2420.

**Legal proceedings.**

Encroachments, **93**, 2499.

**Obstructions.**

Break in Corydon mill dam an obstruction, **94**, 1915; repaired, **95**, 2407.

List of bridges over the river between Olean, N. Y., and Pittsburg, Pa., authorized and constructed, **94**, 1917; **95**, 2409; **96**, 2199; **97**, 2427, 2428; **98**, 2205, 2206. List of bridges over the river above Tarentum, **99**, 2448.

**Operations.**[a]

**1892–93.** Minor repairs to existing works; 3,240 c. y. rocks and bowlders forming a bar removed at Pithole Ripple, **93**, 2498, 2499.

**1893–94.** Existing works repaired; dam below Tionesta Creek built and repaired; dam at Cowshannock built, and dike in course of construction; 3,311 c. y. rock and other obstructions removed, **94**, 1913.

**1894–95.** Dike at Cowshannock completed; 6,645 tons rock and other obstructions removed, **95**, 2406.

**1895–96.** Dike built at Cowshannock; existing works repaired, **96**, 2196.

**1896–97.** Some dams and dikes repaired; 1,373 c. y. bowlders and some snags removed, **97**, 2425.

**1897–98.** Red Bank dike extended; banks at Hickory Island protected; miscellaneous repairs made to works; over 3,000 c. y. bowlders and other obstructions removed, **98**, 2202, 2203.

**1899–1900.** Red Bank dike repaired and paving laid; Nicholson dam repaired; minor repairs made to other works; some snags and nearly 5,000 c. y. rock, etc., removed, **1900**, 3265.

**Physical characteristics.**

Description of, Tarentum to Herr Island, **93**, 2537; **96**, 2213.

Description of, at or near Tarentum, **93**, 2539, 2540; **96**, 2213.

Description of, Olean to Warren. Channel exceedingly shallow with a steep slope, **93**, 2542.

Distances, various points, between Pittsburg and Oil City, **98**, 2204.

Description of, Tarentum to Pennsylvania State line, **99**, 2413. Hydrography, towns, and ripples, **99**, 2421. Geology, **99**, 2439. Probable route for canal connecting the river and Lake Erie, **99**, 2443. Distances on the stream, **99**, 2445.

**Projects.**

After examination, 1892, Lt. Col. Stickney estimated it would cost $2,000 for survey between Tarentum and Herr Island, and $500 for survey at or near Tarentum, **93**, 2536, 2539.

Maj. Hoxie, 1895, estimated it would cost $500,000 to secure slackwater navigation from Herr Island to Tarentum, Pa., with 2 locks and dams (see *Allegheny River, Part C*), **96**, 2214.

Maj. Powell, 1897, estimated it would cost $897.50 to remove Corydon dam to

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[a] List of structures erected 1879–97, **97**, 2426.

## ALLEGHENY RIVER, PA. AND N. Y.—Continued.

### Part B.—Allegheny River, Pa.—Continued.

a depth of 4 f. below low-water level, **98**, 2211; $2,400 to remove dams surveyed in Conewango Creek, 1897, exclusive of damages for destroying or diminishing water power, **98**, 2211, and $90,000 for removal of Waterboro Rapids, **98**, 2212.

Maj. Powell, 1899, estimated it would cost $2,499,384.11 for 8 locks and dams from Natrona to Monterey (the part of improvement probably to be recommended), **99**, 2416. Estimated cost of locks and dams for whole river, $13,704,391.25, **99**, 2419.

By Maj. Powell, 1900, for applying appropriation of 1899 to reconstructing Nicholsons Island dam, completing Red Bank dike and repairing it, making minor repairs at other places, removing obstructions, and continuing survey, **1900**, 3263.

**Surveys.**

Examinations for lock and dam between Tarentum and Herr Island dam, and one at or near Tarentum, ordered by act of July 13, 1892, made under direction of Lt. Col. Stickney, 1892 (report favorable), **93**, 2535, 2538. Surveys ordered by act of August 17, 1894, made under direction of Maj. Hoxie (see *Projects*), **96**, 2212.

Examination from Olean, N. Y., to Warren, Pa., ordered by act of July 13, 1892, made under direction of Lt. Col. Stickney (report unfavorable), **93**, 2540.

Survey for removal of dam near Corydon, Pa., of all the dams on Conewango Creek, and the rapids at or near Waterboro in the creek (the latter a tributary of the Allegheny), ordered by act of June 3, 1896, made by Maj. Powell, 1897, (report unfavorable), **98**, 2211.

Survey for determining what reaches could be made navigable and the number, location, and cost of the necessary locks and dams, ordered by act of June 3, 1896, made under direction of Maj. Powell, 1898 (report partly favorable, see *Projects*), **99**, 2411. Bench marks, **99**, 2446.

MAPS. **98**, 2206.

### Part C.—Allegheny River, Pa. Building locks and dams.

**Appropriations.**

| | | |
|---|---|---|
| 1894, | $40,000, | **95**, 2416. |
| 1896, | 50,000, | **96**, 2207. |
| 1897, | 350,000, | **97**, 2433. |
| 1898, | 300,000, | **98**, 2210. |
| Total, | 740,000 | |

**Contracts.**

**1894.** Lawrence Cement Co., cement, $14,400. Drake & Stratton Co., Ltd., dredging, 14 cents per c. y., p. m., $8,820, **95**, 2417.

**1895.** Patton & Gibson, stone, $1,823.28, **95**, 2417.

**1896.** Atlas Cement Co., Portland cement, $6,300, **96**, 2207.

**1897.** Sloan, McIlvain & Ott Bros., constructing lock No. 2, $220,492.68; No. 3, $175,932.02, **97**, 2433, 2436.

**1898.** W. W. Hegeman & Co., constructing a cofferdam and part of a Chanoine movable dam at Herr Island, $57,357.10, **99**, 2408.

**1900.** E. J. Hingston and O. R. Pihl, cofferdam, foundation, piers, and abutments for part of movable dam and guide cribs, and erecting Chanoine wickets at Herr Island lock and dam, $101,594.82. T. Marshall, two bear-trap gates at Herr Island, $40,149.53, **1900**, 3261, 3262.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 316; **94**, 292; **95**, 326; **96**, 282; **97**, 363; **98**, 376; **99**, 421; **1900**, 483.

BOARD OF ENGINEERS. Convened at Pittsburg, Pa., May 3, 1894, under S. O., No. 20, dated Apr. 24, 1894, to report upon proposed plans for lock and dam below Herr Island. Report, **94**, 1924. (Col. W. P. Craighill, Maj. D. W. Lockwood, Maj. T. Turtle.)

ENGINEERS IN CHARGE:

Lt. Col. A. Stickney, 1892–93. Report, **93**, 2501.

Capt. R. L. Hoxie, 1894–96. Reports, **94**, 1918; (Maj.), **95**, 2410; **96**, 2200.

Maj. C. F. Powell, 1897–. Reports, **97**, 2428; **98**, 2206; **99**, 2404; **1900**, 3257.

ASSISTANT. J. W. Arras. Reports, **93**, 2501; **94**, 1919; **95**, 2414; **96**, 2205; **97**, 2429; **98**, 2207.

**Legal proceedings.** (See *Projects.*)

Purchases of land for locks and dams Nos. 2 and 3, **97**, 2432; **98**, 2209; the last reference including condemnation proceedings for land at No. 3.

The title to the lock ground adjacent to the Six-mile Island lock not obtained at 1900, no satisfactory reply having been received from the Pittsburg city authorities to the offers from the United States, **1900**, 3260.

**Operations.**

**1892–94.** Preparations made for construction of Herr Island work, **93**, 2501; **94**, 1919.

**1894–95.** Construction of lock foundations in progress, **95**, 2413.

## ALLEGHENY RIVER, PA. AND N. Y.—Continued.

### Part C.—Allegheny River, Pa. Building locks and dams—Cont'd.

**1895–96.** Work of preceding year continued, **96**, 2200. (Unit prices of materials, labor, etc.), **96**, 2204.

**1896–97.** Lock and head walls completed, and foundation of the miter walls partly laid, **97**, 2429. (Summary of work performed and materials expended), **97**, 2432.

**1897–98.** Lock and fixed part of dam at Herr Island works under construction; lock No. 3, Springdale, begun, **98**, 2206, 2210. (Summary of work performed and materials expended), **98**, 2209.

**1898–99.** Accessory lock structures, a part of the movable dam at Herr Island, and the Springdale Lock, including its dam, were under construction during the year, **99**, 2405.

**1899–1900.** The lock at Herr Island and some accessories completed, the Chanoine wickets and irons for the navigable pass obtained, and the building of the foundation of the pass commenced, **1900**, 3258.

**Physical characteristics.**

River bottom at Herr Island dam treacherous, **94**, 1919.

Floods and ice damaging works, **94**, 1919; **95**, 2413.

**Projects.**

Herr Island. By Lt. Col. Stickney, 1892–93, for changing the position of works to provide a passageway 55 feet wide at the bank, settling all legal opposition of riparian owners to lock location, **93**, 2501.

By Capt. Hoxie, 1894, modified by Board, 1894, for lock 55 by 330 f. and for dam, pass, and weir of Chanoine type; estimated cost of lock, $225,147; of dam, $373,963.24, **94**, 1924. Modified by Maj. Powell, 1898, by providing for navigable pass 500 f. wide instead of one 250 f.; for substitution of two bear-trap dams 94 f. long each for two Chanoine wicket weirs; and for a fixed masonry dam with three 4½-f. valve culverts for a Boulé dam 20 f. wide in the 55-f. passageway above mentioned, **98**, 2206, 2207.

After failure of cofferdam, 1894, Maj. Hoxie proposed dredging out foundation of lock to 30 f. below pool level, deposit of stratum of concrete at this depth under water in concrete form of piles; redeposit of dredged material, after starting foundations on the concrete stratum, for a certain distance, and completion by means of a cofferdam (drawings of details), **95**, 2412. Estimated cost, $82,644; completed for $22,203.16 less, **96**, 2202, 2205.

Nos. 2 and 3. Act of 1896 authorized beginning work at Six-mile Island and at Springdale under continuous contract. General project prepared and approved, 1896–97, for timber dams and concrete locks, the lift of the locks to be 11 and 12 f. respectively; the useful dimensions of the lock chambers to be 56 by 289.5 f., **97**, 2432.

**Survey.**

MAPS. (See *Projects*, 3d par., *drawings*.

## ALLIGATOR HEAD HARBOR, MATAGORDA BAY, TEX.

**Commerce.**

Unimportant, **1900**, 2464.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900**, 397.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–1900. Report, **1900**, 2462.

ASSISTANT. E. M. Hartrick. Report, **1900**, 2465.

**Physical characteristics.**

Description of; Alligator Head is on the mainland at the foot or western end of Matagorda Bay, **1900**, 2463.

**Survey.**

Examination with a view to preparing plans and estimates for removal of bars and to furnishing an inlet for ocean-going vessels, ordered by act of Mar. 3, 1899, made, 1899, under direction of Capt. Riché (report unfavorable), **1900**, 2463.

## ALLIGATOR RIVER, N. C.

**Commerce.**

The greater part of the commerce is carried in a steamer with a net tonnage of 105 tons, making two round trips during the week, except for a short time in the summer, during which time it makes but one trip, **95**, 1387.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 177; **87**, 123; **95**, 192.

## ALLIGATOR RIVER, N. C.—Continued.

ENGINEERS IN CHARGE:

Capt. J. Mercur, 1884–87. Reports, **84**, 1059; **87**, 992.

Capt. F. A. Hinman, 1887. Report, **87**, 991.

Maj. W. S. Stanton, 1892–95. Report, **95**, 1384.

ASSISTANT. Lt. E. W. Van C. Lucas. Report, **95**, 1385.

**Physical characteristics.**

Description of; the stream rises in Hyde County and flows in a generally northeasterly direction to Albermarle Sound, entering it about opposite the mouth of the Pasquotank River, **95**, 1386.

**Project.**

In 1895 Maj. Stanton estimated that a beneficial improvement could be made at an estimated cost of $6,000, **95**, 1385.

**Surveys.**

Examination ordered by acts of Aug. 2, 1882, and Aug. 5, 1880, made under direction of Capt. Mercur, 1882 (report unfavorable), **84**, 1059, and Capt. Hinman, 1886 (report unfavorable), **87**, 991.

Survey ordered by act of Aug. 17, 1894, made under direction of Maj. Stanton, 1894 (see *Projects*), **95**, 1384.

## ALLIGATOR RIVER, S. C.

**Commerce.**

Present and prospective, important, **87**, 1123.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 139.

ENGINEER IN CHARGE. Capt. W. H. Bixby. Reports, **87**, 1114, 1117.

ASSISTANT. R. Whitford. Report, **87**, 1118.

**Physical characteristics.**

Description, **87**, 1114.

**Plans.**

By Capt. Bixby, 1887, for improvement of Alligator River and waters connecting Santee River and Bull's Bay by excavating a 6-f. channel, 100 feet in width; estimated cost, $183,240, **87**, 1118.

**Survey.**

Examination and survey ordered by act of Aug. 5, 1886, made 1887 under direction of Capt. Bixby, **87**, 1117.

MAPS. **87**, 1118.

## ALLOUEZ (ALLONEZ) BAY AND NEMADJI RIVER, LAKE SUPERIOR, WIS. (See *Nemadji River; Duluth; Superior.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 316.

ENGINEERS IN CHARGE:

Maj. J. B. Quinn. Report, **91**, 2512.

Col. O. M. Poe. Report, **91**, 2513.

**Physical characteristics.**

Description of, **91**, 2513.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Quinn, **91**, 2512. Indorsement of Col. Poe (unfavorable to Nemadji River), **91**, 2512.

## ALLOWAY CREEK, N. J.

**Appropriations.**

1890, $6,000, **91**, 1087.
1892, 3,000, **92**, 938.
1894, 3,000, **95**, 1070.
1896, 3,000, **96**, 929.
1899, 3,000, **99**, 1359.

Total, 18,000

**Contracts.**

**1891.** F. C. Somers, dredging, 18 cents per c. y., **91**, 1087.

**1892.** F. C. Somers, dredging, 18 cents per c. y. ($2,232), **93**, 1177.

**1895.** B. F. Sweeten & Son, dredging, 19 cents per c. y., and piie dike construction at $3.47 per l. f. ($2,561), **95**, 1070.

**1897.** J. L. Grim, dredging, 18 cents per c. y., and pile dike construction at $3.60 per l. f. ($2,790), **97**, 1221.

**1899.** River and Harbor Improvement Co., dredging, 15 cents per c. y., $2,475, **99**, 1359.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 1102; **90**, 92; **91**, 117; **92**, 118; **93**, 127; **94**, 116; **95**, 130; **96**, 119; **97**, 150; **98**, 154; **99**, 175; **1900**, 203.

ENGINEERS IN CHARGE:

Lt. Col. H. M. Robert, 1888–91. Reports, **90**, 906, 910.

Maj. C. W. Raymond, 1891–1900. Reports, **91**, 1086; **92**, 937; **93**, 1176; **94**, 855; **95**, 1069; **96**, 928; **97**, 1220; (Lt. Col.) **98**, 1099; **99**, 1358; **1900**, 1583.

## ALLOWAY CREEK, N. J.—Continued.

ASSISTANT. L. Y. Schermerhorn. Report, **90**, 907.

**Operations.**

**1890–91.** 18,341 c. y. dredged, **91**, 1086.

**1891–92.** 4,893 c. y. dredged, **92**, 937.

**1892–93.** 15,000 c. y. dredged, **93**, 1176.

**1895–96.** 7,806 c. y. dredged, **96**, 928.

**1896–97.** 404 l. f. of dike constructed, **97**, 1220.

**1897–98.** 4,269 c. y. dredged, **98**, 1099.

**1899–1900.** 14,690 c. y., p. m., dredged, **1900**, 1584.

**Physical characteristics.**

Description of, **90**, 907; **91**, 1086.

**Projects.**

By Lt. Col. Robert, 1889, for dredging a channel 6 f. deep at m. l. w. and 60 f. wide from Quinton to a point about 1,000 f. above Upper Hancock Bridge; from thence a channel of the same depth and a least width of 75 f. down the stream to the lower side of the bar at the Square; at a locality in the creek known as the Canal, in addition to obtaining a channel of the dimensions named, the width of the creek to be increased to about 150 f. between its low-water lines; at the Square the dredged channel to be supplemented by a deflecting dike 500 f. in length, formed of the dredged material, with its channel face protected by a riprap of stone. Estimated cost, $25,000, **90**, 913; **92**, 937.

By Maj. Raymond, 1894, for a wooden dike at the Square, 300 f. long, to be backed by dredged material, **95**, 1069.

By Lt. Col. Raymond, 1899, for enlarging existing channels at the shoals below Upper Hancock Bridge, as far as available funds would permit, **99**, 1358.

**Survey.**

Ordered by act of Aug. 11, 1888; made, 1889, under direction of Lt. Col. Robert, **90**, 910.

## ALPENA HARBOR, MICH. (See *Thunder Bay Harbor and River, Mich.*)

**Appropriations.**

1876, $4,500, **77**, 111, 142, 934.
1882, 15,000, **83**, 1853.
1890, 5,500, **91**, 2767; **93**, 2921.

Total, 25,000

**Contracts.**

**1877.** Thomas M. Hubbell, dredging, 17 cents per c. y., **78**, 1236.

**1882.** C. S. Barker, dredging, 20 cents per c. y., **83**, 1853.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 32, 44; **71**, 42; **76**, 106; **77**, 110; **78**, 126; **80**, 219; **81**, 297; **82**, 292; **83**, 301; **84**, 303; **85**, 327; **86**, 321; **87**, 289; **93**, 381.

ENGINEERS IN CHARGE:

Capt. F. U. Farquhar, 1870–83. Reports, **71**, 158; **77**, 933; (Maj.) **83**, 299.

Maj. G. Weitzel, 1874–77. Reports, **76**, 548; **77**, 933.

Maj. F. Harwood, 1878–83. Reports, **78**, 1235; **80**, 2036; **81**, 2244; **82**, 2329.

Lt. Col. O. M. Poe, 1883–87. Reports, **83**, 1852; **84**, 2036; **85**, 2129; **86**, 1125; **87**, 2249.

Maj. W. Ludlow, 1893. Report, **93**, 2920.

ASSISTANTS:

H. A. Ulffers. Report, **76**, ii, 548.
R. Strohman. Report, **84**, 2037.

**Operations.**

**1877–78.** Dredging by contract, completed, **78**, 126, 1235.

**1882–83.** 16,900 c. y. dredged, **83**, 1852.

**1883–84.** 21,294 c. y. dredged; project completed, **84**, 2040; **87**, 2249.

**Physical characteristics.**

**71**, 158, 159.

**Plans.**

By Maj. Farquhar, for crib piers 20 f. wide, and pier-head cribs 32 f. wide, $53,496.30, **71**, 159.

**Private (Corporate, Private) work.**

The Alpena Harbor Improvement Company expended $40,000 in piers and dredging; collecting toll from vessels drawing over 4 f. of water, **71**, 42, 158, 159.

Private parties expended in 1875, $3,000 in dredging, **76**, ii, 548.

**Projects.**

By Maj. Weitzel, for dredging channel 200 f. wide by 13 f. deep 1,100 f. out from the pier, $4,764, **76**, ii, 548; $4,500, **77**, 110, 934.

By Maj. Harwood, 1881, for dredging a channel 14 f. deep; estimated cost, $25,000, **81**, 2244; **84**, 2037.

**Surveys.**

Under direction of Maj. Farquhar, 1870, **71**, 158, 159.

Under direction of Maj. Weitzel, by H. A. Ulffers, 1875, **76**, 106.

## ALSEA BAY, HARBOR, AND RIVER, OREG.

**Appropriation.**
1896, $3,000, **96**, 3241.

**Commerce.**
Description of, **93**, 3441.
Commerce of the country in 1892 small, **93**, 3442; **98**, 2995.

**Contracts.**
**1897.** C. P. Church, removal of obstructions, $1,475, **97**, 3393.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **76**, 116; **78**, 139; **79**, 183; **80**, 242; **91**, 409; **93**, 445; **95**, 459; **96**, 398; **97**, 499; **98**, 488, 501; **99**, 574.

ENGINEERS IN CHARGE:
Maj. N. Michler, 1876, **76**, 116. Report, **76**, ii, 644.
Maj. J. M. Wilson, 1878–79, **78**, 138; **79**, 183. Report, **79**, 1810.
Lt. Col. G. L. Gillespie. Report, **80**, 2336.
Capt. T. W. Symons, 1891–95. Reports, **91**, 3246; (Maj.) **93**, 3440; **95**, 3505.
Capt. W. L. Fisk, 1896–98. Reports, **96**, 3241; **97**, 3393; (Maj.), **98**, 2972–2995.
Capt. W. W. Harts, 1899. Report, **99**, 3212.

ASSISTANTS:
G. F. Cramer, **76**, ii, 645.
R. A. Habersham, **79**, 1810. Reports, **79**, 1812; **80**, 2337.
J. S. Polhemus. Report, **91**, 3246.
J. R. Savage. Report, **93**, 3443.

**Operations.**
**1897–98.** Obstructions removed from 31 miles of the lower part of the river, **98**, 2972.

**Physical characteristics.**
Description of, **76**, ii, 645; **79**, 1810, 1811, 1812; **80**, 2337; **91**, 3248; **93**, 3441, **95**, 3506; **98**, 2996.

The river rises in the Coast Range, Oreg., is about 50 or 55 miles long, and empties into the Pacific Ocean about 12 miles south of Yaquina Bay. Alsea Bay and that portion of the river affected by the tides have an area of 3.7 square miles. About 45 miles from its mouth it divides into two forks. It has a number of tributaries. **93**, 3441.

The country adjacent to the forks constitutes the upper Alsea Valley, or the prescribed head of the examination of 1897, **98**, 2996.

**Projects.**
In 1895 Capt. Symons estimated it would cost $3,000 to improve the lower part of the river, by the removal of rocks and other obstructions for a length of 31 miles, the plan of improvement adopted, **95**, 3506; **96**, 3241.

The project having been completed, the unexpended balance, $1,044.16, was returned to the Treasury, 1899, by Capt. Harts, **99**, 3212.

**Surveys.**
Examination by G. F. Cramer, 1875, **76**, 116, ii, 645.
Survey 1878–79 by R. A. Habersham, **78**, 139; **79**, 183, 1810.
Survey 1879 ordered of harbor and bar, **79**, 183. Made by R. A. Habersham, 1879, **80**, 2337. Report of Lt. Col. Gillespie (unfavorable to harbor), **80**, 2336.
Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Capt. Symons (unfavorable), **91**, 3246.
Examination of the inner navigation of the river ordered by act of July 13, 1892, made in the same year under the direction of Capt. Symons (report favorable), **93**, 3440.
Survey ordered by act of August 17, 1894, made in 1895 under the direction of Capt. Symons (see *Projects*), **95**, 3505.
Examination from the head of tide water to upper Alsea Valley ordered by act of June 3, 1896, made, 1897, by Capt. Fisk (report unfavorable to further improvement), **98**, 2995.

## ALTAMAHA RIVER, GA. (See *Darien Harbor; Doboy Bar, Ga.; Mississippi* and *Tennessee rivers;* and *Transportation Routes to the Seaboard.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1881, | $5,000, | **81**, | 1105. |
| 1882, | 15,000, | **82**, | 1177. |
| 1884, | 15,000, | **84**, | 1116. |
| 1886, | [a] 10,000, | **86**, | 1108. |
| 1888, | 10,000, | **88**, | 1038. |
| 1890, | 15,000, | **90**, | 1371. |
| 1892, | 15,000, | **92**, | 1263. |
| 1894, | 10,000, | **95**, | 1479. |
| 1896, | 10,000, | **96**, | 1259. |
| 1899, | 6,000, | **99**, | 1580. |
| Total, | 111,000 | | |

**Commerce.**
Importance of improvement to commerce, **86**, 1107, 1109; **87**, 1177.
Increase in river trade and reduction in freight rates consequent upon improvement, **88**, 1037; **90**, 1382.
Value of lumber interests, **91**, 1533.
In 1892–93 the freight carried was valued at $1,614,860, **93**, 1563; in 1898, $540,000, not including lumber, **98**, 1307.
Total commerce, 1898, valued at $1,170,000, **99**, 1579; 1899, at $2,525,000, **1900**, 1941.

[a] Part of $20,000, of which amount $10,000 was to be applied to Doboy Bar, **87**, 1178.

## ALTAMAHA RIVER, GA.—Continued.

**Contracts.**

**1883.** R. S. Burnett, removing rock, $4.70 per c. y., and construction of wing-dams, **83,** 929.

**1884.** E. H. Gaynor, construction of wing-dams, **85,** 1221.

**1888.** M. A. Sweeney & Bro., repairing snag boat, $10,000, **89,** 1248.

**1895.** W. T. Gaynor, mattresses, $1 per s. y.; fascines, $1.65 per c. y.; pile work, $1.50 per l. f.; fender piles, $50 per cluster; tie piles, $20 per group; sawn timber, $25 per M f., b. m.; iron bolts, 5 cents per lb.; riprap stone, $3.05 per c. y. ($48,000), **95,** 1480.

**Engineers.**

Chief of Engineers. Reports, **81,** 175; **82,** 170; **83,** 181; **84,** 187; **85,** 187, 191; **86,** 186; **87,** 149; **88,** 141; **89,** 161; **90,** 144; **91,** 181; **92,** 177; **93,** 193; **94,** 178; **95,** 202; **96,** 181; **97,** 230; **98,** 226; **99,** 261; **1900,** 298.

Engineer in Charge:

Col. Q. A. Gillmore, 1880–87. Reports, **81,** 1105, 1107; **82,** 1176; **83,** 926; **84,** 1114; **85,** 1218, 1234; **86,** 1105; **87,** 1176.

Capt. O. M. Carter, 1888–97. Reports, **88,** 1035; **89,** 1245; **90,** 1369, 1372; **91,** 1531; **92,** 1261; **93,** 1561; **94,** 1169; **95,** 1477; **96,** 1257; **97,** 1513.

Capt. C. E. Gillette, 1898. Reports, **98,** 1306; **99,** 1578; **1900,** 1939.

Assistants:

W. G. Williamson. Report, **81,** 1109.

Capt. J. C. Post. Report, **83,** 930.

Capt. T. N. Bailey. Reports, **84,** 1116; **85,** 1236.

Lt. O. M. Carter. Reports, **85,** 1221; **86,** 1108.

W. R. Curtis. Report, **88,** 1038.

F. C. Armstrong. Reports, **90,** 1368; **91,** 1535; **92,** 1264.

R. S. Burnett. Reports, **93,** 1565; **94,** 1172; **95,** 1480; **96,** 1260.

**Operations.**

**1881–82.** Construction of snag boat, **82,** 1176.

**1882–83.** Examination of river preparatory to active operations, **83,** 927.

**1883–84.** Removal of 1,800 c. y. rock at Town and Piney bluffs, 323 snags and 185 leaning trees, **84,** 1115.

**1884–85.** Construction of training wall for improvement of Beards Bluff Bar, removal of snags, and protecting caving banks, **85,** 1218.

**1885–86.** Construction of 4 spur jetties at Beard's Bluff Bar, **86,** 1106.

**1886–87.** Removal of snags and trees by snag boat *Toccoa*, **87,** 1177.

**1888–89.** 157 snags and logs removed from the channel and 221 overhanging trees from the banks, **89,** 1247.

**1889–90.** 170 snags and logs removed from the river and 309 overhanging trees cut from the banks, **90,** 1370.

**1890–91.** 150 snags and 466 trees removed from the channel and banks, **91,** 1532.

**1891–92.** 521 snags removed from the channel and 1,100 overhanging trees cleared from the banks; construction of wattled pile spur dams begun at Beards Bluff, and repairs made to old training wall at that point, **92,** 1262.

**1892–93.** 799 piles were driven; 4,389 c. y. fascines, 371 c. y. riprap stone, 12,502 ft. b. m. timber, 1,285 lbs. bolts, 1,630 s. y. mattresses were used in the construction of spur dams, training wall, etc.; 1,252 l. f. pile work wattled; 79 l. f. shore protection constructed; about 1,400 snags and other obstructions removed, **93,** 1562.

**1893–94.** About 5,000 logs and other obstructions removed from the banks and channel; 66 fender piles driven; 45 c. y. rock removed, **94,** 1171.

**1894–95.** 143 piles driven; 3,004 s. y. mattresses were sunk with 100 c. y. riprap stone; 4,985 f. b. m. timber were fastened to pile work by 631 lbs. of bolts, **95,** 1478.

**1896–97.** Over 300 obstructions removed from the banks and channel; 2½ c. y. rock excavated and removed, **97,** 1514.

**1898–99.** 174 snags and other obstructions removed from banks and channel, **99,** 1579.

**1899–1900.** 160 c. y. rock removed from channel through Town Bluff Shoals, over 1,000 overhanging trees, snags and other obstructions removed at Beards Bluff, and construction of a training dike at Griners Bar in progress, **1900,** 1940.

**Physical characteristics.**

Description of, **90,** 1372, 1374, 1378.

Permanent improvement not to be obtained because of the obstructions brought into the river at every freshet, **93,** 1564.

**Projects.**

By Col. Gillmore, 1880, for low-water channel 80 f. wide and 3 f. deep, from the confluence of the Oconee and Ocmulgee to Darien, 155 miles, by the removal of rock, bars, and snags, at an estimated cost of $60,000, **81,** 1106; **87,** 1176.

By Lt. Carter, 1890, for a navigable steamboat channel 3 f. deep at ordinary summer low water between the junctions of the Oconee and Ocmulgee rivers and Darien, by removal of rock shoals, sand bars, snags, and logs from the channel

## ALTAMAHA RIVER, GA.—Continued.

and overhanging trees from the banks, construction of deflecting dikes, closing incipient cut-offs, and revetting caving banks; total estimated cost, $128,627.50, **90,** 1370, 1380; **92,** 1261.

In 1893-94 Capt. Carter estimated that from $3,000 to $5,000 would be required each year for maintenance, **94,** 1172.

**Surveys.**

Examination, 1880, by W. G. Williamson, **81,** 1107.

Made under direction of Lt. Carter, 1890, **90,** 1372.

Examinations and surveys prior to 1890, **90,** 1377.

MAPS. **84,** 1116; **85,** 1222; **93,** 1562.

## ALTON HARBOR, ILL. (See *Mississippi River between mouths of Illinois and Ohio Rivers.*)

## ALVISO CREEK, HARBOR, RIVER, AND SLOUGH, CAL.

**Appropriation.**

**1899,** $48,000, **99,** 3162.

**Commerce.**

Description of, **93,** 3238; **97,** 3334.

**Contracts.**

**1899.** E. V. McCann, dredging, 6 cents per c. y. ($12,402), expired by limitation, **1900,** 4214.

**1900.** A. C. Aiken, dredging, 14.48 cents per c. y. ($29,930.16), **1900,** 4214.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91,** 393; **93,** 425; **97,** 488; **99,** 554; **1900,** 624.

ENGINEERS IN CHARGE:

Lt. Col. W. H. H. Benyaurd, 1891-93. Reports, **91,** 2964; **93,** 3236.

Maj. C. E. L. B. Davis, 1897. Report, **97,** 3343.

Maj. W. H. Heuer, 1899. Reports, **99,** 3161; (Lt. Col.) **1900,** 4213.

ASSISTANT. F. C. Turner. Report, **97,** 3346.

**Physical characteristics.**

Description of, **91,** 2964; **93,** 3237; **97,** 3345.

Creek situated at the upper end of San Francisco Bay; formerly known as Steamboat Slough; in 1892, from Alviso to the mouth of the slough, 3½ miles, there was a good, navigable channel, **93,** 3237.

**Project.**

By Maj. Davis, 1896, for dredging a channel with a least depth of 7 f. and a least width of 60 f., estimated cost $47,855, **97,** 3344, **99,** 3162.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Benyaurd (report unfavorable), **91,** 2964.

Examination ordered by act of July 13, 1892, made in the same year by Lt. Col. Benyaurd (report unfavorable), **93,** 3237.

Survey ordered by act of June 3, 1896, made in the same year by Maj. Davis (report unfavorable), **97,** 3343.

## AMELIA RIVER, FLA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85,** 191.

ENGINEER IN CHARGE. Capt. W. T. Rossell. Report, **85,** 1285.

**Surveys.**

Reference to previous examinations, **85,** 1284.

Examination ordered by act of July 5, 1884, made under direction of Capt. Rossell, 1884 (report unfavorable), **85,** 1285.

## AMERICAN RIVER, CAL. (See *Sacramento and Feather Rivers and Tributaries.*)

**Commerce.**

Unimportant, **95,** 3337.

**Engineers.**

CHIEF OF ENGINEERS. Report, **95,** 440.

ENGINEER IN CHARGE. Maj. W. H. Heuer, 1895. Report, **95,** 3335.

ASSISTANT. Lt. H. Deakyne. Report, **95,** 3337.

**Physical characteristics.**

Description of, **95,** 3336.

In 1895 the river was not considered navigable. It had about 15 rapids. A number of bars existed, caused by material washed into it by mining operations; this material in flood periods flowed into the Sacramento River, **95,** 3336.

**Project.**

In 1895 Maj. Heuer estimated it would cost $1,077,500 to prevent an inflow of sand into the Sacramento River, **95,** 3337.

**Surveys.**

Examination with a view to preventing sand flow into the Sacramento River, ordered by act of Aug. 17, 1894, made, 1895, by Maj. Heuer (report unfavorable) **95,** 3335.

## AMITE RIVER AND MANCHAC BAYOU AND PASS, LA.[a] (See *Manchac Bayou, La.*)

**Appropriations.**

1880,[b] $8,000, **80**, 1157.
1881,[b] 5,000, **81**, 1260.
1886,[b] 2,000, **86**, 1241.
1888, 5,000, **88**, 1248.
1890, 3,800, **90**, 1741.
1892, 2,500, **92**, 1486.
1894, 2,500, **95**, 1748.
1896, 2,500, **96**, 1492.
1899, 2,500, **99**, 1837.

Total, 33,800

**Commerce.**

Dimensions of vessels on Mississippi Sound, **68**, 487.

Benefiting by improvement of the waterways, **95**, 1748.

Comparison of its value with the cost of the improvement effected, **96**, 1491.

**Contracts.**

**1880.** E. Glasscock, removing obstructions, **81**, 1279; unsatisfactory progress of contract, **83**, 1103.

**1894.** De Witt Dilworth, hire of dredging plant, $125 per day, **95**, 1749.

**1899.** Dilworth-Schudder Dredging Co., dredging, $50 per day of 8 hours ($4,500), **99**, 1838.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **68**, 55, 486; **79**, 112; **80**, 143, 145, 146; **81**, 192, 197; **82**, 188, 194; **83**, 206; **84**, 210; **85**, 215; **86**, 213; **87**, 181; **88**, 168; **89**, 196, 202; **90**, 177; **91**, 223; **92**, 217; **93**, 241; **94**, 222; **95**, 247; **96**, 216; **97**, 280; **98**, 271; **99**, 320; **1900**, 363.

ENGINEERS IN CHARGE:

Maj. M. D. McAlester, 1868. Reports, **68**, 474, 486.

Maj. C. W. Howell, 1879–83. Reports, **80**, 1156, 1185; **81**, 1279; **82**, 1372.

Maj. A. Stickney, 1883–84. Reports, **82**, 1414; **83**, 1103; **84**, 1263.

Capt. T. Turtle, 1884.

Maj. W. H. Heuer, 1885–87. Reports, **85**, 1391; **86**, 1239; **87**, 1364.

Capt. W. L. Fisk, 1888–91. Reports, **88**, 1247; **89**, 1484, 1513, 1528; **90**, 1740.

Maj. J. B. Quinn, 1891–99. Reports, **91**, 1820; **92**, 1485; **93**, 1812; **94**, 1354; **95**, 1747; **96**, 1490; **97**, 1756; **98**, 1467; **99**, 1837.

Maj. H. M. Adams, 1900. Report, **1900**, 2243.

ASSISTANTS:

Lt. J. K. Hezlep, **68**, 486. Report, **68**, 493.

H. S. Douglass. Report, **80**, 1185.

J. C. Buchanan. Report, **82**, 1415.

Capt. D. W. Lockwood. Report, **83**, 1104.

H. C. Collins. Report, **84**, 1264.

**Operations.**[c]

**1881–82.** Obstructions removed from 6½ miles of river, **82**, 1372.

**1882–83.** Obstructions removed from 36 miles of river, **83**, 1104.

**1883–84.** Operations prosecuted by hired labor; 8 miles of river cleared of obstructions, **84**, 1264; **85**, 1392.

**1888–89.** 846 trees and stumps removed from the channel and banks, **89**, 1485.

**1890–91.** Snagging operations resumed, **91**, 1821.

**1891–92.** 445 snags, logs, and trees cleared from the channel, **92**, 1486.

**1892–93.** About 200 obstructions removed, **93**, 1812.

**1894–95.** 4,080 c. y. dredged to form a turning basin, and about 5,000 obstructions removed, **95**, 1748.

**1899–1900.** Sand bars at the mouths of Amite River and Bayou Manchac removed, shoal places in Bayou Manchac, near Hope Villa, La., dredged, and obstructions in Amite River for a distance of 6 miles above Bayou Manchac and in Bayou Manchac removed, **1900**, 2244.

**Physical characteristics.**

Flood height near New Orleans, **68**, 487, 489, 492; **80**, 1186.

**Plans.**

Maj. McAlester, 1868, for a continuous channel with low-water depth of 7 f. between Mississippi River and Lake Pontchartrain, via Bayou Manchac, Amite River, Lake Maurepas and Pass Manchac, by canal from Mississippi to head of Crocodile Bayou, thence by river and lake navigation for 75 miles, estimated cost, $3,800,444; considered the least favorable route between Mississippi River and Lake Pontchartrain, **68**, 492, 496. In place of the above route suggested the following: A canal from Mississippi River near Carrollton to a point near Metaire, thence via the "new canal" to Lake Pontchartrain, 7 miles, estimated cost, $785,939, **68**, 492, 493, 496.

By Maj. Stickney, 1882, for removal of obstructions from lower part of Bayou Manchac, from its junction with the Amite River to Lake Maurepas and thence to Bobbins; estimated cost, $3,450, **82**, 1415.

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[a] Amite River and Bayou Manchac, La.; Survey—Report, Dec. 17, 1842; estimates, $6,000 and $13,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Amite River.

[c] Advantage of work done by hired labor, **85**, 1392.

## AMITE RIVER AND MANCHAC BAYOU AND PASS, LA.—Cont'd.

In 1888 Capt. Fisk considered the cost of improving Bayou Manchac as a water route from Mississippi River to Mississippi Sound excessive, **89**, 1515.

**Private (State) work.**

$75,000 expended by State of Louisiana in clearing river of obstructions, **80**, 1187.

**Projects.**

By Maj. Howell, 1879, for the improvement of the river from Bayou Manchac to Lake Maurepas, giving a low-water depth of 5 f. by the removal of snags and logs, at an estimated cost of $23,760, **80**, 1157. Improvement not considered permanent, **83**, 1105; **84**, 210.

After examination in 1889, Capt. Fisk reported the river as unworthy of improvement for more than 5 miles above the mouth of Bayou Manchac, and estimated such improvement, snagging, and dredging to cost $5,000, **89**, 1529. Permanent improvement not looked for, **91**, 1821.

Annual expenditure of $2,500 required to maintain the river and bayou in navigable condition, **92**, 1486.

In 1893 Maj. Quinn estimated it would cost $2,500 annually for maintenance, **93**, 1813.

Engineer property pertaining to the work of improvement sold at public auction in 1896, **96**, 1491.

By Maj. Quinn, 1899, subproject for removing obstructions in Amite River and Bayou Manchac gathering since 1895, **99**, 1837.

**Surveys.**

By H. L. Douglass, **80**, 1185.

Manchac Bayou and Pass. Ordered by act of June 14, 1880, **80**, 146, made under direction of Maj. Howell, 1881, **82**, 1415.

Examinations of Bayou Manchac for a water route from the Mississippi River to Mississippi Sound ordered by act of Aug. 11, 1888, made, 1888, under direction of Capt. Fisk, **89**, 1513.

Examination of Amite River ordered by act of Aug. 11, 1888, made under direction of Capt. Fisk, **89**, 1528.

## AMMONOSOOK CANAL, N. H.[a]

## ANACOSTIA RIVER, D. C. AND MD. (See *Potomac River.*)

## ANCLOTE BAY, HARBOR, AND RIVER, FLA. (See *Clearwater Harbor.*)

**Appropriation.**

1899, $5,000, **99**, 1638.

**Commerce.**

Description of, **95**, 1575; **98**, 1361.

Anclote Anchorage, at the mouth of the river, a great rendezvous for small vessels engaged in the sponge business in the immediate and adjoining waters, **95**, 1574.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 199; **95**, 222; **98**, 247; **99**, 285; **1900**, 324.

ENGINEERS IN CHARGE:

Capt. W. T. Rossell, 1885. Report, **85**, 1280.

Maj. T. H. Handbury, 1895. Report, **95**, 1573.

Lt. Col. W. H. H. Benyaurd, 1898. Report, **98**, 1361.

Capt. H. Jervey, 1899. Report, **99**, 1638.

Capt. T. H. Rees, 1900. Report, **1900**, 2028.

ASSISTANTS:

A. W. Barber. Report, **85**, 1280.

J. W. Sackett. Report, **95**, 1575.

O. N. Bie. Report, **98**, 1362.

**Physical characteristics.**

Description of, **95**, 1574; **98**, 1361.

The river flows into the Gulf of Mexico on the west coast of Florida, and is about 20 miles long, **95**, 1574.

**Operations.**

**1899-1900.** 11,987 c. y. dredged, **1900**, 2028.

**Projects.**

By Lt. Col. Benyaurd, 1897, for 6-f. channel, m. l. w., 100 f. wide from Anclote Anchorage to Sponge Harbor, and thence a 4-f. channel, m. l. w., to the county bridge at Tarpon Springs; estimated cost, $51,500, **98**, 1362; **99**, 286.

**Surveys.**

Examination ordered by act of July 5, 1884, made under direction of Capt. Rossell, 1884 (report unfavorable), **85**, 1280.

Examination ordered by act of Aug. 17, 1894, made, 1894, under the direction of Maj. Handbury (report favorable), **95**, 1575.

Survey ordered by act of June 3, 1896, made under direction of Lt. Col. Benyaurd, 1897 (report favorable), **98**, 1361. (See *Projects.*)

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[a] Surveys.—Report, Feb. 18, 1828. No estimate. (H. Doc. 482, 55th Cong., 2d sess.)

**ANDALUSIA, ILL.** (See *Mississippi River from St. Paul to Des Moines Rapids.*)

**ANDRÉ BAYOU, LA.** (See *Barataria Bay.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80,** 146; **81,** 197.

ENGINEER IN CHARGE. Maj. C. W. Howell. Report, **81,** 1305.

ASSISTANT. H. S. Douglass. Report, **81,** 1306.

**Survey.**

Ordered by act of June 14, 1880, **80,** 146. Examination made under direction of Maj. Howell (report unfavorable to immediate improvement), **81,** 1306.

**ANDROSCOGGIN RIVER (at and below Brunswick), ME.** (See *Brunswick Harbor.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81,** 77; **82,** 77; **84,** 73.

ENGINEER IN CHARGE. Col. G. Thom, 1882–84. Reports, **82,** 527; **84,** 473.

ASSISTANT. Lt. W. T. Rossell. Report, **82,** 528.

**Plans.**

By Col. Thom, 1881, for dredged channel at Brunswick, 150 f. wide and 6½ f. deep at low water, through the shoals above Foster Island, with bank protection and closure of channel north of Cow Island; no information as to necessity of improvement or its benefit to commerce; estimated cost, $34,000, **82,** 528, 530.

**Survey.**

Ordered by act of Mar. 3, 1881, made under direction of Col. Thom, 1881, **82,** 527.

Examination below Brunswick (report unfavorable), **84,** 473.

**ANDURA CREEK, VA.** (See *Nandua Creek, Va.*)

**ANGELINA RIVER, TEX.** (See *Neches River.*)

**ANGUILLE RIVER, ARK.** (See *L'Anguille River.*)

**ANITA ROCK.** (See *San Francisco, Cal.*)

**ANNACOCK HARBOR, VA.** (See *Onancock Harbor, Va.*)

**ANNAPOLIS HARBOR, MD.**

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $5,000, | **80,** 634. |
| 1881, | 5,000, | **81,** 874. |

Total, 10,000

**Commerce.**

Benefit of proposed improvement, **79,** 578, 579.

Benefit to commerce from proposed improvement small, **81,** 874; **82,** 850; **85,** 134.

Extremely small, and Naval Academy averse to increase of, **97,** 1312.

**Contract.**

**1886.** The American Dredging Co., dredging, 8 cents per c. y., **86,** 877.

**Defense.**

Strategic value of Annapolis Harbor in defense of Washington, **79,** 578, 579; **82,** 850; **85,** 134.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78,** 69; **79,** 81; **80,** 102; **81,** 135, 150; **82,** 131; **83,** 136; **84,** 143; **85,** 134; **86,** 134; **87,** 98; **97,** 175.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1876–88; **78,** 69. Reports, **79,** 574; (Lt. Col.) **80,** 633; **81,** 871; **82,** 850; **83,** 676; **84,** 900; **85,** 886; **86,** 877; **87,** 863; (Col.) **88,** 761.

Col. P. C. Hains, 1895–97. Report, **97,** 1309.

ASSISTANTS:

Capt. C. B. Phillips. Report, **79,** 578.

Capt. J. W. Cuyler, **79,** 574. Report, **79,** 575.

John L. Seager, **79,** 574.

W. R. Hutton. Report, **81,** 872.

C. P. E. Burgwyn. Report, **88,** 762.

Lt. C. W. Kutz. Report, **97,** 1310.

**Operations.**

**1885–86.** Dredging shoals within the harbor, **86,** 877.

**1886–87.** Dredging of shoals continued, **87,** 863.

**Physical characteristics.**

General description, **79,** 575, 576; **81,** 872; **97,** 1311. Bars at mouth of harbor, **79,** 566. Tides, **79,** 574, 575.

**Plans.**

By Capt. Cuyler. 1. To dredge channel 150 f. wide and 24 f. deep, connecting deep waters of bay with deep waters of Severn River, at an estimated cost of $55,000. 2. To construct a series of light shore groins or deflectors to maintain channel, at an estimated cost of $17,000, **79,** 575.

## ANNAPOLIS HARBOR, MD.—Continued.

By Maj. Craighill, an estimated expenditure, per annum, of $10,000 for dredging, **79**, 574, 575, 577. Correspondence relative to proposed improvement of harbor, **79**, 577, 578.

**Projects.**

By Col. Craighill, 1880, for a channel through the bars abreast of the Naval Academy, by dredging to a width of 150 f. and depth of 24 f. low water; estimated cost, $66,000, **81**, 872; **85**, 134.

In 1881 Col. Craighill recommended the postponement of operations as the amount available, $10,000, was not sufficient to effect any substantial improvement, **81**, 874.

In 1896 Col. Hains estimated that to dredge a channel 3½ miles long with side slopes of 1 on 3, 28 f. deep at m. l. w., would cost $142,000, **97**, 1310.

**Surveys.**

Included in Coast Survey, 1844–45, **79**, 575.

Examination by Capt. Phillips, 1876. Report, **79**, 578.

By Capt. Cuyler and J. L. Seager, 1878–79. Report, **79**, 575.

By W. F. Smith, 1886, of shoals in harbor, **86**, 134.

Survey with a view to obtaining a ship's channel 150 f. wide and 28 f. deep m. l. w., from Chesapeake Bay to the wharves of U. S. Naval Academy, ordered by act of June 3, 1896. Report submitted by Col. Hains in 1896 (see *Projects*), **97**, 1309.

## APALACHICOLA BAY, FLA.[a] (See *Chattahoochee* and *Mississippi rivers.*)

**Appropriations.**

| | | |
|---|---|---|
| 1833, | $8,700.00, | act Mar. 2. |
| 1834,[b] | 500.00, | act June 30. |
| 1838, | 10,000.00, | act July 4, 1836, and July 7, 1838. |
| 1839,[c] | 9,900.00, | act Mar. 3. (Treas. Doc. No. 373, 1882.) |
| 1840,[b] | 150.29, | act May 8. |
| 1880, | 10,000.00, | **80**, 1077. |
| 1881, | 10,000.00, | **81**, 1191. |
| 1882, | 25,000.00, | **82**, 1267. |
| 1884, | 10,000.00, | **84**, 1177. |
| 1886, | 12,000.00, | **86**, 1141. |
| 1888, | 20,000.00, | **88**, 1161. |
| 1890, | 20,000.00, | **90**, 1624. |
| 1892, | 20,000.00, | **92**, 1399. |
| 1894, | 15,000.00, | **95**, 1613. |
| 1896, | 12,000.00, | **96**, 1342. |
| 1899, | 20,000.00, | **99**, 1651. |
| Total, | 203,250.29 | |

**Commerce.**

Increase of, due to improvement, **82**, 1267; **84**, 1176.

In 1895 the commerce of the bay seemed to warrant a wider and deeper channel, **95**, 1613.

Description of, **1900**, 2093.

Increase of commerce immediate effect of improvement, **1900**, 2093.

**Contracts.**

**1880.** W. A. Alexander, dredging, 46¾ cents per c. y., **81**, 1190.

**1881.** J. Thomlinson, dredging, 29½ cents per c. y., **82**, 1269; **83**, 980.

**1882.** J. Maguire, dredging, 22½ cents per c. y., **83**, 960.

**1885.** S. N. Kimball, dredging, 29⅜ cents per c. y., **85**, 1259.

**1886.** S. N. Kimball, dredging, $39\frac{9}{10}$ cents per c. y., **87**, 1265.

**1889.** Alabama Dredging and Jetty Co., dredging, 24¾ cents per c. y., **89**, 1374.

**1891.** Alabama Dredging and Jetty Co., dredging, 25 cents per c. y., **92**, 1399.

**1892.** R. Moore, dredging, 33 cents per c. y., **93**, 1692.

**1895.** R. Moore Dredging Co., dredging, 24 cents per c. y., **95**, 1614.

**1897.** R. Moore Dredging Co., dredging, 24 cents per c. y., **97**, 1607.

**1899.** R. Moore, dredging, 24½ cents per c. y., ($18,535), **1900**, 2093.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 136; **81**, 183; **82**, 179; **83**, 189; **84**, 197; **85**, 194; **86**, 193; **87**, 163; **88**, 152; **89**, 175; **90**, 157; **91**, 196; **92**, 192; **93**, 211; **94**, 196; **95**, 223; **96**, 199; **97**, 254, 262; **98**, 250; **99**, 289; **1900**, 329.

ENGINEERS IN CHARGE:

Capt. A. N. Damrell, 1870–84. Reports, **80**, 1076; **81**, 1190; **82**, 1266; **83**, 980; **84**, 1175.

Capt. W. T. Rossell, 1884–86. Report, **85**, 1258.

Lt. W. M. Black, 1886–87. Report, **86**, 1140.

Capt. R. L. Hoxie, 1887–89. Report, **87**, 1265; **88**, 1160.

Capt. P. M. Price, 1889–93. Reports, **89**, 1372; **90**, 1623; **91**, 1694; **92**, 1397; **93**, 1690.

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[a] Approaches to Apalachicola: Surveys—Report, Dec. 24, 1832; estimate, $8,772. Feb. 23, 1835 (maps; no reports). H. Doc. No. 482, 55th Cong., 2d sess.

[b] Survey of East Pass.

[c] For deepening the straight channel of East Pass to Apalachicola.

## APALACHICOLA BAY, FLA.—Continued.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1249; **95**, 1611; **96**, 1339; **97**, 1605, 1655; **98**, 1377.

Capt. C. A. F. Flagler, 1899—. Reports, **99**, 1649; **1900**, 2091.

Assistant. W. H. Barber. Report, **85**, 1260.

**Operations.**

**1881–82.** 51,943 c. y. dredged, resulting in increasing the channel depth from 2½ to 3 f., **82**, 1267.

**1882–83.** Formation of a dredged channel 75 f. wide and 9½ f. deep, **83**, 980.

**1883–84.** 2,290 c. y. dredged, resulting in a channel from 60 to 75 f. wide and 9½ f. deep, **84**, 1176.

**1884–85.** 27,000 c. y. removed in the formation of a dredged channel 60 f. wide and 9½ f. deep, **85**, 1259.

**1886–87.** 4,607 c. y. dredged at Carrabelle and 18,885 c. y. at Apalachicola Bar, **87**, 1265.

**1887–88.** 7,688 c. y. dredged from the bar, **88**, 1161.

**1889–90.** 65,547 c. y. mud and sand removed from the channel, **90**, 1624.

**1891–92.** 54,458 c. y. dredged, **92**, 1398.

**1892–93.** 55,126 c. y. dredged, **93**, 1691.

**1895–96.** 54,253 c. y. dredged, **96**, 1341–1346.

**1896–97.** 45,000 c. y. dredged, **97**, 1606.

**1899–1900.** 75,653 c. y. dredged, **1900**, 2093.

**Physical characteristics.**

Description of, **97**, 1657; **98**, 1377; **99**, 1649.

**Projects.**

By Capt. Damrell, 1879, for dredging a channel 100 f. wide and 11 f. deep through the bar in the bay at the mouth of the river; estimated cost $100,000, **79**, 823; **85**, 1258; **87**, 1265.

Auxiliary works needed to make improvement permanent, **80**, 1077; **86**, 193; **87**, 1265.

In 1890, after the appropriation of $107,000, it was estimated that $40,000 would be required for completion, **90**, 1624.

Maj. Mahan, 1896, estimated that it would cost $350,000 to improve the channel, and that from $20,000 to $30,000 would be required annually for maintenance, **97**, 1656–1659.

**Surveys.**

Minor examinations, **94**, 1251; **95**, 1613.

Harbor lines established, **96**, 1341–1346.

Survey with a view to obtaining a channel 100 f. wide and 18 f. deep at m. l. w. ordered by act of June 3, 1896 report (favorable; see *Projects*), submitted by Maj. Mahan, 1896, **97**, 1655.

Maps. **86**, 1142; **90**, 1624.

## APALACHICOLA RIVER. (Including the Cut-Off, Lees Slough, Lower Chipola.) (See *Chipola River.*)

**Appropriations.**

| | |
|---|---|
| 1828, | $3,000, act, May 23. |
| 1830, | 2,000, act, April 23. |
| 1831, | 8,000, act, March 2. |
| 1874, | 10,000, **74**, 76, 896. |
| 1875, | 10,000, **75**, 81, ii, 9. |
| 1878, | 8,000, **78**, 80, 591. |
| 1879, | 5,000, **79**, 103, 822. |
| 1880, | 2,000, **80**, 1075. |
| 1881, | 1,500, **81**, 1190. |
| 1882, | 2,000, **82**, 1265. |
| 1884, | 1,000, **84**, 1175. |
| 1886, | 1,000, **86**, 1155. |
| 1888, | 2,000, **88**, 1160. |
| 1890, | 2,000, **90**, 1622. |
| 1892, | 5,000, **92**, 1401. |
| 1894, | 5,000, **95**, 1616. |
| 1896, | 5,000, **96**, 1350. |
| 1899, | 3,000, **99**, 1654. |
| Total, | 75,500 |

**Commerce.**

The country bordering on the river dependent almost entirely upon the river for transportation, **96**, 1350. In 1898 it was improbable that the river would be much used above the Cut-Off, even if cleared out, **98**, 1424.

**Engineers.**

Chief of Engineers. Reports, **70**, 32, 63; **71**, 69; **72**, 63, 64; **73**, 67; **74**, 75; **75**, 81; **76**, 72; **77**, 71; **78**, 80, 81; **79**, 103; **80**, 135, 140; **81**, 182, 189; **82**, 178, 185; **83**, 189; **84**, 197; **85**, 198; **86**, 1196; **87**, 162; **88**, 151; **89**, 175; **90**, 156; **91**, 197; **92**, 193; **93**, 212; **94**, 197; **95**, 224; **96**, 199; **97**, 254; **98**, 251, 259; **99**, 290; **1900**, 330.

Engineers in Charge:

Maj. C. B. Reese, 1870, **71**, 68.

Capt. A. N. Damrell, 1870, **71**, 68.

Col. J. H. Simpson, 1870–1873. Reports, **71**, 577; **72**, 583, 612.

Lt. Col. W. F. Raynolds, 1873, **73**, 66.

Capt. A. N. Damrell, 1873–84. Reports, **73**, 698; **74**, 896; **75**, ii, 9; **76**, 494; **77**, 414; **78**, 590; **79**, 821, 823; **80**, 1075; **81**, 1188; **82**, 1264–1304; **83**, 978; **84**, 1174.

Capt. W. T. Rossell, 1884–86. Report, **85**, 1275.

## APALACHICOLA RIVER—Continued.

Lt. W. M. Black, 1886–87. Report, **86**, 1153.

Capt. R. L. Hoxie, 1887–89. Reports, **87**, 1263; **88**, 1159.

Capt. P. M. Price, 1889–93. Reports, **89**, 1372, 1416; **90**, 1621; **91**, 1696; **92**, 1400; **93**, 1692.

Maj. F. A. Mahan, 1894–99. Reports, **94**, 1252; **95**, 1615; **96**, 1346; **97**, 1609; **98**, 1381, 1423.

Capt. C. A. F. Flagler, 1899—. Reports, **99**, 1653; **1900**, 2095.

ASSISTANTS:

Capt. A. N. Damrell. Report, **72**, 613.

C. F. Trill. Report, **72**, 620.

Walter Griswold, **73**, 698.

M. J. Mack. Report, **73**, 698.

P. J. Quattlebaum. Report, **79**, 824.

H. Haines. Report, **82**, 1305.

M. J. Mack, **86**, 1154.

T. Robinson. Reports, **89**, 1418; **91**, 1697.

**Estimates.** (See *Plans* and *Projects.*)

By Col. Simpson and Capt. Damrell, for 11-f. channel at river mouth, 200 f. wide, $185,000; **72**, 584, 612. Various estimates submitted by C. F. Trill, **72**, 612, 623.

By Capt. Damrell and Mr. Mack, for river improvement, $80,333, **73**, 698, 699.

By Capt. Damrell, for an 11-f. channel at river mouth, $100,000, **79**, 823.

By P. J. Quattlebaum, for an 11-f. channel at river mouth, $85,000, **79**, 824.

**Obstructions.**

Bridges without draws existing on the Chipola prevent effectually any boats from reaching Marianna, **98**, 1424.

**Operations.**

**1838.** Dredging through the bar, **72**, 619.

**1874–75.** Removal of rafts, snags, etc., and straightening the channel at Moccasin Slough, **75**, 81, ii, 9.

**1875–76.** Improving channel at Moccasin Slough and Styx River, **76**, 72, 494.

**1876–77.** Removal of rafts and stumps at Moccasin Slough, **77**, 71, 414.

**1877–78.** Snags, logs, etc., removed, a dam 130 f. long built, and 486 c. y. of earth removed, **78**, 80, 591.

**1878–79.** Snags, rafts, and overhanging timber removed at various points along the river. Chipola cut-off opened, **79**, 103, 821.

**1879–80.** Canal 70 f. wide and 5 f. deep, cut between Apalachicola River and Moccasin Slough; removal of raft from Styx River, **80**, 1076.

**1880–81.** Removal of 676 snags and overhanging trees and 2,233 c. y. of dredged material, **81**, 1189.

**1881–82.** 165 snags and overhanging trees, 2 rafts, and 3,000 c. y. of dredged material removed, **82**, 1265.

**1882–83.** Removal of drift from Moccasin Slough, **83**, 979.

**1883–84.** Widening Moccasin Slough Canal by removal of 240 c. y. of clay and 3,679 snags and overhanging trees, **84**, 1175.

**1885–86.** Removal by hired labor of 110 snags and logs from channel above Moccasin Slough, **86**, 1155; completion of improvement as originally projected, **86**, 1154.

**1886–87.** 33 snags and 141 leaning trees removed, **87**, 1264.

**1887–88.** Improvement completed as projected, **88**, 1160.

**1888–89.** 304 logs and snags removed from the channel and 2,328 overhanging trees and logs removed from the banks, **89**, 1372.

**1889–90.** 366 logs and snags removed from the channel and 1,246 overhanging trees cut from the banks, **90**, 1622.

**1890–91.** 582 logs, snags, and stumps removed from the channel and 2,142 overhanging trees cleared from the banks, **91**, 1697.

**1891–92.** 313 snags cleared from the channel and 878 trees, logs, and stumps removed from the banks, **92**, 1401.

**1892–93.** About 15,000 obstructions removed from the banks and channels, **93**, 1694.

**1894–95.** About 10,000 obstructions removed, **95**, 1616.

**1896–97.** About 5,000 obstructions removed, and snag boat repaired, **97**, 1610.

**1897–98.** About 200 obstructions removed, **98**, 1382.

**1899–1900.** 6,262 snags and overhanging trees, 633 cords brush, and 235 c. y. clay removed from the channel and the banks of the river; 536 l. f. jetties finished and 70 l. f. fascines laid, **1900**, 2097.

**Physical characteristics.**

Description of, **72**, 618, 622; **73**, 699; **79**, 824; **97**, 1609; **98**, 1381, 1382.

Description of the cut-off and the Chipola River, **89**, 1416; **93**, 1694; **94**, 1253; **98**, 423.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Damrell, 1881, for improvement of Chipola River from Marianna to the Apalachicola River by dredging and removal of obstructions; estimated cost, $21,000, **82**, 1304.

**Projects.** (See *Estimates* and *Plans.*)

By Col. Simpson and Capt. Damrell for dredging an 11-f. channel 100 f. wide, through the bar at mouth of river, $100,000, **72**, 63, 584, 612, 619.

## APALACHICOLA RIVER—Continued.

By Capt. Damrell, 1874, for the formation of a channel of navigable width and 6 f. depth by the removal of snags and overhanging trees, and by utilizing Styx River and Moccasin Slough, in avoiding the worst part of the Apalachicola River; estimated cost, $80,000, **73**, 698. Project accomplished in 1880 by expenditure of $37,244, **80**, 1076. In addition to original project, Chipola Cut-off opened to Whites Bluff, **82**, 1265. Annual appropriations required for the preservation of improvement, $2,000, **85**, 1267; **86**, 1154.

Examination of the Chipola River from its mouth to Wewachitka and the cut-off and Lee Slough running from the Apalachicola to the Chipola River, made in 1889, resulted in the recommendation that a channel 60 f. wide and 5 f. deep should be cleared through the cut-off, Lee Slough, and the Lower Chipola River; estimated cost, $7,500, **89**, 1417.

The project, 1891, therefore, provided for a channel 100 f. wide and 6 f. deep, at low water, in the Apalachicola River by the removal of snags and overhanging trees, and widening and straightening Moccasin Slough and the elbow, and for a channel through Lee Slough 60 f. wide and 5 f. deep at low water, by the removal of logs, snags, and overhanging trees, **91**, 1696.

Capt. Price, 1893, estimated that $2,000 would be required annually for maintenance of an unobstructed channel, **93**, 1694.

**Surveys.**

Under direction of Col. Simpson, by Capt. Damrell and C. F. Trill, 1871, **71**, 577. Reports, **72**, 584, 612, 613, 620.

Under direction of Lt. Col. Raynolds and Capt. Damrell, by M. J. Mack, 1872–73. Report, **73**, 698.

Under direction of Capt. Damrell, by C. J. Quattlebaum, 1879. Reports, **79**, 823, 824.

Ordered by act of June 14, 1880, **80**, 140, made under the direction of Capt. Damrell, **82**, 1304.

Examination of Chipola River from its mouth to Marianna, ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Price, **89**, 1416. (See *Projects*, 3d par.)

Examination of the Chipola River, Fla., from Marianna to its connection with the Apalachicola River, ordered by act of June 3, 1896, made by Maj. Mahan, 1897, (report unfavorable), **98**, 1423.

MAPS. **91**, 1697.

## APPOMATTOX RIVER. (See *James River, Va.*)

## APPOMATTOX RIVER, VA., from Petersburg to mouth.[a] (See *Petersburg Harbor.*)

**Appropriations.**

| | | |
|---|---|---|
| 1852, | $22,500, | **66**, 7. |
| 1871, | 50,000, | **71**, 74, 606. |
| 1872, | 40,000, | **72**, 70, 692. |
| 1873, | 30,000, | **73**, 76, 782. |
| 1874, | 30,000, | **74**, 86, ii, 47. |
| 1875, | 30,000, | **75**, 89, ii, 84. |
| 1876, | 30,000, | **76**, 65, 306; **77**, 61, 292. |
| 1878, | 30,000, | **78**, 67, 465. |
| 1879, | 20,000, | **79**, 79, 522. |
| 1880, | 20,000, | **80**, 657. |
| 1881, | 20,000, | **81**, 901. |
| 1882, | 35,000, | **82**, 901. |
| 1884, | 25,000, | **84**, 913. |
| 1886, | 18,750, | **86**, 959. |
| 1888, | 15,000, | **88**, 768. |
| 1890, | 15,000, | **90**, 1025. |
| 1892, | 15,080, | **92**, 1094. |
| 1894, | 5,000, | **95**, 1286. |
| 1896, | 5,000, | **96**, 1076. |
| 1899, | 5,000, | **99**, 1477. |
| Total, | 461,330 | |

**Contracts.**

**1871.** G. H. Ferris, dredging 150,000 c. y., **72**, 692. B. S. Burch, dredging 50,000 c. y., **72**, 692; **73**, 784.

**1872.** Albany Dredging Co., dredging, **73**, 784.

**1873.** G. H. Ferris, dredging, 24¾ cents per c. y., **74**, ii, 47.

**1874.** G. H. Ferris, dredging, 20 cents per c. y., **75**, ii, 85.

**1875.** G. H. Ferris, dredging, 12½ cents per c. y., **75**, ii, 86.

**1876.** G. H. Ferris, dredging, 15$\frac{9}{16}$ cents per c. y., **76**, 307; **77**, 291. W. H. Beard, dredging, 30 cents per c. y., **77**, 291, 292.

**1881.** S. West, dredging, 20 and 23 cents per c. y., **81**, 902.

**1882.** G. H. Ferris, dredging, 32 cents per c. y., **82**, 901.

**1884.** B. A. Davis, piles, G. V. Scott & Sons, lumber, W. F. Gatling, brush and poles, **84**, 914. A. F. Hull, dredging, 13¼ cents per c. y., **85**, 1029, 1031.

[a] Examination.—Report (favorable), Nov. 26, 1852. (H. Doc. No. 482, 55th Cong., 2d sess.)

## APPOMATTOX RIVER, VA., from Petersburg to mouth—Cont'd.

**1886.** West Point Engine and Machine Co., boiler of tow-boat, **87**, 978.

**1889.** Cline & Isaac, jetty construction, **89**, 953.

**1890.** W. Jameson, construction of wattle jetty, 79 cents per l. f.; timber jetty with mattress protection, $3.24; Dike A $1.06 and Dike B 98 cents per l. f., **91**, 1302.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7; **70**, 31, 68; **71**, 73; **72**, 70; **73**, 76; **74**, 86; **75**, 89; **76**, 65; **77**, 60; **78**, 66; **79**, 78; **80**, 106; **81**, 143; **82**, 139, 903; **83**, 143; **84**, 147; **85**, 155; **86**, 150; **87**, 117; **88**, 101; **89**, 118; **90**, 106; **91**, 150; **92**, 152; **93**, 163, 166; **94**, 149; **95**, 171, **96**, 155; **97**, 193; **98**, 196; **99**, 226; **1900**, 258, 265.

BOARDS OF ENGINEERS.

A commission, appointed in 1852, reported a plan for improvement. S. Doc. 1, 35, 1, Part ii, 394.

Convened Aug. 29, 1870. Recommended adoption of much of the work done by private and corporate authority, under plan of Mr. H. D. Bird. Modified plan in regard to future work. Report, **74**, ii, 50. Reconvened at Baltimore Nov. 19, 1870. Report, **74**, ii, 53.

(Col. J. H. Simpson, Lt. Col. John Newton, and Maj. W. P. Craighill.)

ENGINEERS IN CHARGE:

Maj. Wm. P. Craighill, 1878–90. Reports, **73**, 784; **74**, ii, 47; **75**, ii, 86; **76**, 307; **77**, 292; **78**, 463; **79**, 521; (Lt. Col.) **80**, 655; **81**, 898; **82**, 898, 907; **83**, 687; **84**, 913; (Col.) **88**, 768; **89**, 955.

Capt. Chas. B. Phillips, in temporary charge. Report, **78**, 463.

Capt. F. A. Hinman, 1884–87. Reports, **85**, 1029; **86**, 959; **87**, 978.

Lt. G. J. Fiebeger, 1889–92. Reports, **89**, 952, 957; **90**, 1025, **91**, 1300.

Lt. E. Burr, 1892–94. Reports, **92**, 1093; **93**, 1333, 1345; **94**, 981.

Capt. T. L. Casey, 1895–99. Reports, **95**, 1284; **96**, 1074; **97**, 1369; **98**, 1227; **99**, 1476.

Maj. J. B. Quinn, 1900. Report, **1900**, 1766.

ASSISTANTS:

H. D. Bird. Reports, **72**, 693; **73**, 784; **74**, ii, 47; **75**, ii, 86; **76**, 307; **77**, 292; **78**, 465; **80**, 659.

Capt. James W. Cuyler. Reports, **79**, 522, 524, 525, 526; **80**, 657.

Capt. T. Turtle. Reports, **82**, 898, 907, 911; **83**, 687.

Lt. C. McD. Townsend. Reports, **83**, 688; **84**, 914.

H. J. Gielow. Report, **87**, 981.

**Estimates.** (*Plans* and *Projects.*)

By Board of Engineers, for channel 60 f. by 12 f., $250,000; $125,000 additional to make the work permanent; and $10,000 for annual repairs and dredging, **74**, ii, 54.

By Maj. Craighill, to complete channel 80 f. by 10 f., $153,000, and $20,000 for annual dredging and repairs, **74**, ii, 46, 47.

By Maj. Craighill and Capt. Cuyler, revised, completion of existing project, $42,000, **79**, 522.

**Legislation.**

A joint-stock company incorporated in 1824 by the State of Virginia for improvement of the river, **74**, ii, 54.

The assent of the U. S. given by act of Mar. 3, 1825.

**Operations.**

**1870–71.** Preliminary operations, examination made, **71**, 608.

**1871–72.** Removal of 150,000 c. y. from south channel; dredging through Puddledock Marsh, **72**, 70, 692.

**1872–73.** Completion of south channel, 60 to 80 f. wide and 10 f. deep; dredging in Puddledock Cut, and completion of deflector 250 f. in length, **73**, 76, 782, 784.

**1873–74.** Dredging in and above Puddledock Cut; 123,095 c. y. removed, **74**, 86, ii, 46, 48.

**1874–75.** Dredging between upper end of Puddledock Cut and Petersburg, **75**, 89, ii, 84.

**1875–76.** Removal of 129,270 c. y. by contract, **76**, 65, 306–308.

**1876–77.** Dredging and construction of embankment by contract. (Channel of sufficient depth for vessels drawing 11 f. of water to reach the city.) **77**, 292.

**1877–78.** Removal of 421 c. y. of rock by blasting; construction of 812 l. f. of longitudinal dikes and 3 wing-dams, **78**, 66, 464, 465.

**1878–79.** Dredging of 15,248 c. y.; repairs, protection, and extension of wing-dams; construction of dams, training-walls, and dikes, **79**, 78, 523.

**1879–80.** Dredging 9,305 c. y.; repair and construction of wing-dams and dike, **80**, 657.

**1880–81.** Dredging, construction, and repair of wing-dams in progress, **81**, 898.

**1881–82.** Dredging and repairs to dikes, **82**, 898.

**1882–83.** (Improved condition of river, **83**, 143, 687, 694.) Construction of jetties and their cost, **83**, 143, 688.

**1883–84.** 26,727 c. y. dredged; construction and repairs of dikes, **84**, 147, 914. (Improved condition of river, **84**, 913.) Cost of work, **84**, 915.

**APPOMATTOX RIVER, VA., from Petersburg to mouth**—Cont'd.

**1884-85.** 51,300 c. y. dredged by contract from Puddledock Cut; extension and repair of dikes by hired labor, **85,** 1029.

**1885-86.** 70,124 c. y. dredged by contract from Puddledock Cut; 190 l. f. pile and brush revetments built by hired labor, **86,** 958.

**1886-87.** 25,047 c. y. dredged from channels; repair of jetties, dams, and training-walls; 348 l. f. revetment built at Puddledock Cut; construction of training-wall at Rushmore's commenced, **87,** 979.

**1888-89.** 15,175 c. y. dredged, jetties repaired, and closure dike to Jetty No. 20 prolonged, **89,** 952.

**1889-90.** 10,435 c. y. dredged, **90,** 1025.

**1890-91.** 13,512 c. y. dredged from Puddledock Shoal and deposited behind closure dike; 22 l. f. of jetty built; Rushmore Dam, etc., built, **91,** 1301.

**1891-92.** 892 l. f. of brush and pile dike built at Magazine Bend and at Lieutenant Run Dike, and 583 l. f. of the latter dike backed with brush; dam built at Steins Cut and repairs to closure dike at head of Puddledock Cut; 7,867 c. y. gravel used in construction of bank behind the cut, **92,** 1093.

**1892-93.** 31,325 c. y. dredged, 1,475 l. f. of brush dike at Magazine Bend refilled with brush, a new wale piece was placed on the closure dike, and 1,243 l. f. of timber dam at the closure dike constructed and 350 l. f. rebuilt, **93,** 1334.

**1893-94.** 17,150 c. y. dredged, and 6,850 c. y. of it placed behind closure dike to strengthen it, **94,** 982.

**1894-95.** 7,200 c. y. dredged and placed behind closure dike, **95,** 1285.

**1895-96.** 18,000 c. y. dredged, and 6,050, 2,800, and 4,750 c. y. of it were wheeled ashore at Bradway, Rushmores dike, and at closure dike, respectively, **96,** 1075.

**1898-99.** 10,250 c. y. dredged from vicinity of Rushmores dike, **99,** 1476.

**1899-1900.** 7,200 c. y. dredged from vicinity of Rushmores dike, 12,550 c. y. at Sunken Island; 3,150 c. y. at Mills Bar; and closure dike repaired, **1900,** 1766, 1767.

**Physical characteristics.** (See *Operations,* 1876-77, 1882-83, 1883-84.)

Described, **71,** 606-608; **74,** ii, 50-56; **79,** 529. Sketch showing current observations at Magazine Bend, **78,** 464.

Description of the various divisions of the river, **93,** 1336.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Cuyler, for change in direction of jetties to oblique instead of perpendicular to the shore, **79,** 524.

By Lt. G. J. Fiebeger, 1889, for diversion of the waters of the Appomattox River into the old North Channel, involving dredging, dam, embankment, and bridge construction, and the purchase of overflowed lands; estimated cost, $387,926.21, **89,** 960.

**Private (city and corporate) work.**

History from 1824 to 1870, **74,** ii, 54-57; **77,** 293.

Estimate by H. D. Bird, engineer for Lower Appomattox Co., for a 12-f. channel, $173,004.15, **74,** ii, 57.

Dredging, etc., by the city of Petersburg, **71,** 73, 606-608; **72,** 692; **75,** ii, 86; **78,** 464; **79,** 521. The Lower Appomattox Co. expended, in 1870, $75,186.70, **74,** ii, 57.

Construction of a dredge, 1884, by city of Petersburg, Va., **84,** 914; work done by city of Petersburg, **86,** 960.

Dredging done by the city near Petersburg, **88,** 768.

History of improvements carried on by the city of Petersburg, **89,** 957, 961.

**Projects.**

By Board of Engineers, 1870, for the attainment of a channel with a depth of 12 f. at high water and a width as great as the river will bear, the improvement to be accomplished by regulating works, aided by dredging; estimated cost, $428,000, **71,** 73, 606; **74,** ii, 53; **85,** 155; **87,** 117.

In 1887 a revision of the estimated cost for the completion of the project was $33,810, **87,** 978, 983. This was increased in 1889 to $45,890, or $30,080 for completion, **89,** 953.

Lt. Burr in 1893 submitted a revised estimate of cost of the improvement, making a total of $68,090, **93,** 1336.

By Capt. Burr in 1894 for retaining the appropriation of 1894 until dredging is necessary, the appropriation not being considered sufficient to warrant the undertaking of any extension of the contracting works, **95,** 1285.

The deflection of the river in the old channel just above the bridge at Petersburg recommended by Maj. Casey, 1899 (see *Plan of 1889*), **99,** 1477.

By Maj. Quinn, 1899, for expenditure of funds in dredging at Sunken Island, Mills Bar, and Magazine Bend, **1900,** 1767.

**Surveys.**

An elaborate survey made a short time before the war, **70,** 68.

Under direction of Maj. Craighill, 1870, **70,** 68.

Under direction of Maj. Craighill, 1873-74, **74,** ii, 46.

### APPOMATTOX RIVER, VA., from Petersburg to mouth—Cont'd.

Under direction of Lt. Col. W. P. Craighill, 1881–82, **82**, 904.

Ordered by act of Aug. 11, 1888, made, 1889, under Lt. Fiebeger, **89**, 957.

Examination and survey of harbor at Petersburg and Appomattox River ordered by act of July 13, 1892, made, 1892, by Lt. Burr (report unfavorable), **93**, 1347, 1348.

Maps, **89**, 960; **93**, 1340.

### APPONAUG HARBOR, COWESSET BAY, R. I.

**Commerce.**

In 1893 the interests involved seemed to make the desired improvement of local but not of national importance, **93**, 870.

**Engineers.**

Chief of Engineers. Report, **93**, 71.

Engineer in Charge. Capt. W. H. Bixby, 1892–93. Report, **93**, 869.

**Physical characteristics.**

The harbor is located at the northwest corner of Greenwich Bay, on the west side of Narragansett Bay, and about 10 miles south of Providence, **93**, 869.

**Survey.**

Examination ordered by act of July 14, 1892, made by Capt. Bixby, 1893 (report unfavorable), **93**, 869.

### APPOQUINIMINK RIVER, DEL.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $5,000, | **91**, 1161. |
| 1892, | 5,000, | **92**, 951. |
| 1894, | 5,000, | **95**, 1114. |
| 1896, | 5,000, | **96**, 947. |
| 1899, | 5,000, | **99**, 1375. |
| Total, | 25,000 | |

**Contracts.**

**1891.** F. C. Somers, dredging, 19 cents per c. y., **91**, 1162.

**1892.** F. C. Somers, dredging, 11 cents per c. y., p. m., **93**, 1198.

**1895.** F. L. Somers, dredging, 14.7 cents per c. y., p. m., **95**, 1115. (Contract annulled July 27, 1896, **97**, 1261.)

**1897.** Egan & Bochman, dredging, 10 cents per c. y., p. m., **97**, 1262.

**1899.** River and Harbor Improvement Co., dredging, 12 cents per c. y., p. m., **1900**, 1634.

**Engineers.**

Chief of Engineers. Reports, **81**, 129; **89**, 112; **90**, 102; **91**, 121; **92**, 121; **93**, 131; **94**, 119; **95**, 135; **96**, 124; **97**, 158; **98**, 161; **99**, 185; **1900**, 211.

Engineers in Charge:

Col. J. N. Macomb. Report, **81**, 826.

Maj. W. F. Smith, U. S. agent, 1890–1900. Reports, **90**, 943; **91**, 1161; **92**, 950; **93**, 1197; **94**, 875; **95**, 1114; **96**, 946; **97**, 1261; **98**, 1149; **99**, 1374; **1900**, 1633.

Assistants:

W. S. Edwards. Report, **81**, 826.

A. Stierle. Report, **90**, 943.

**Operations.**

**1890–91.** 24,981 c. y. dredged, **91**, 1161.

**1892–93.** 38,575 c. y., p. m., dredged, **93**, 1197.

**1898–99.** 60,091 c. y. dredged, **99**, 1375.

**1899–1900.** 37,596 c. y. dredged, **1900**, 1633.

**Physical characteristics.**

Description of, **90**, 944.

**Plans.**

By Col. Macomb, 1880, for improvement of creek by dredging from Odessa to its mouth, a distance of 9¼ miles, so as to give 6 f. depth at m. l. w.; estimated cost, $71,382, **81**, 826.

**Projects.**

By Maj. Smith, 1889, excavation of a channel 8 f. deep at m. l. w., with a width of 80 f., from the bridge at Odessa to Townsends Wharf, 3¼ miles, and a width of 100 f. from this wharf to the mouth, 5 miles; estimated cost, $39,963, **90**, 947.

**Surveys.**

By W. S. Edwards, 1880, **81**, 826.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Smith, **90**, 945.

## AQUIA CREEK, VA.

### Appropriations.

| | | |
|---|---|---|
| 1872, | $1,500, | **72**, 69, 688; **73**, 74, 772; **74**, 84. |
| 1873, | 2,000, | **73**, 74, 772; **74**, 84; **75**, 92. |
| 1875, | 2,000, | **75**, 92, ii, 122. |
| 1878, | 5,000, | **78**, 71, 510. |
| 1890, | 10,000, | **91**, 1257. |
| 1892, | 5,000, | **92**, 1044. |
| 1894, | 3,000, | **95**, 1227. |
| 1896, | 3,000, | **96**, 1038. |
| Total, | 31,500 | |

### Commerce.

Requirements of, do not justify carrying out the project, **74**, ii, 37.

Resources of the country tributary to Aquia Creek, **90**, 1100.

Improvement of benefit to commerce. Two vessels able to pass in the dredged channel, **98**, 1194

### Contracts.

**1872.** A. A. Dodge, dredging, 15 cents per c. y., **75**, ii, 122.

**1875.** A. A. Dodge, dredging, 13 cents per c. y., **76**, 348.

**1878.** G. H. Ferris, dredging, 11¾ cents per c. y., **79**, 604.

**1891.** F. C. Somers, dredging, 12½ cents per c. y., **91**, 1257.

**1893.** F. C. Somers, dredging, 11 cents per c. y. ($3,300), **93**, 1288.

**1894.** T. P. Morgan, dredging, 15 cents per c. y. ($2,400), **95**, 1223.

**1897.** Baltimore Dredging Co., dredging, 18 cents per c. y. ($3,240), **98**, 1192.

### Engineers.

CHIEF OF ENGINEERS. Reports, **71**, 76; **72**, 69, 71; **73**, 74; **74**, 84; **75**, 92; **76**, 67; **77**, 64; **78**, 71; **79**, 84; **89**, 135; **90**, 121; **91**, 139; **92**, 140; **93**, 151; **94**, 139; **95**, 160; **96**, 144; **97**, 179; **98**, 182; **99**, 210.

ENGINEERS IN CHARGE:

Maj. Wm. P. Craighill. Reports, **71**, 620; **72**, 688, 707; **73**, 771; **74**, ii, 37.

S. T. Abert, U. S. agent, **75**, ii, 110. U. S. C. E., 1874–91. Reports, **75**, ii, 121; **76**, 348; **77**, 359; **78**, 510; **79**, 603; **90**, 1096, 1097.

Lt. Col. P. C. Hains, 1891–92. Report, **91**, 1255.

Maj. C. E. L. B. Davis, 1892–95. Reports, **92**, 1042; **93**, 1286; **94**, 944; **95**, 1224.

Maj. C. J. Allen, 1896–99. Reports, **96**, 1036; (Lt. Col.), **97**, 1324; **98**, 1193; **99**, 1423.

ASSISTANTS:

Capt. Chas. B. Phillips. Report, **72**, 708.

J. E. Weyss and G. Thompson; **72**, 707, 708.

### Estimates.

(See *Plans* and *Projects.*)

By Capt. Phillips, for 51,667 c. y. of dredging and 972 rods of wattling, $13,505.14; **72**, 707, 709. Increased by Maj. Craighill to $18,000, **72**, 69, 71, 688, 708; **73**, 74, 771; **75**, ii, 121.

Increased by S. T. Abert, U. S. C. E., to $20,000, **76**, 67, 348. To complete existing project, $14,500; **77**, 64, 359. The work reported completed, **79**, 84, 605.

### Obstructions.

The Secretary of War, 1892, ordered the Richmond, Fredericksburg and Potomac R. R. to widen the draw of its bridge over the creek and revoked the order in 1893, **93**, 1287.

The Secretary of War, 1895, approved the plans and granted permission to the Richmond, Fredericksburg and Potomac R. R. to erect temporary structures in the creek and to close the draw to navigation while new girders were being placed in the bridge, **95**, 1227.

### Operations.

**1874-75.** 17,576 c. y. were removed, **75**, ii, 122.

**1875-76.** The channel begun in 1874 was completed 40 f. wide and 4 f. deep, and a portion widened to 80 f., **76**, 348.

**1878-79.** Channels were completed by dredging 5 f. in depth and 50 f. in width, being all that the requirements of commerce demanded, **79**, 84, 605.

**1890-91.** 2,670 l. f. of channel dredged to full width of 80 f. and depth of 6 f., **91**, 1257.

**1891-92.** Channel completed to the Richmond, Fredericksburg and Potomac R. R. bridge, **92**, 1044.

**1893-94.** 28,554 c. y. dredged, **94**, 947.

**1894-95.** 17,731 c. y. dredged, **95**, 1227.

**1897-98.** About 18,000 c. y. dredged, **98**, 1192, 1194.

### Physical characteristics.

Description of, **72**, 708, 709; **74**, ii, 37; **75**, 92; **90**, 1100; **97**, 1324; **98**, 1193.

### Plans.

By S. T. Abert, 1890, excavation of a cut from Brents Point to the Narrows, 150 f. wide and 8 f. deep at the mouth of Austens Creek, with the construction of 100 l. f. of brush and pile dike; estimated cost, $101,278, **90**, 1102; **91**, 1256.

### Projects.

By Capt. Phillips, and concurred in by Maj. Craighill, for dredging a channel 40

## AQUIA CREEK, VA.—Continued

f. wide by 6 f. deep from the "Narrows" to the 6-f. curve below the new railroad bridge, and wattling the channel banks from the "Narrows" to the bridge, 972 r., **72**, 69, 71, 688, 708, 709.

By Maj. Craighill, to expend appropriation of 1872 in dredging a channel 20 f. wide by 4 f. deep from the draw in the railroad bridge toward the "Narrows" as far as practicable, **72**, 69, 689. Completion of, not justified by the wants of commerce, **74**, 37. Modified by S. T. Abert to 50 f. wide and 5 f. deep, **78**, 71, 510; **79**, 84, 604.

By S. T. Abert, 1890, excavation of a channel 80 f. wide and 6 f. deep between the mouth and the "Narrows;" estimated cost, $40,000, **90**, 1097.

By Maj. Davis, 1893, the original project was modified to permit the foot of the slope of dredged material deposited on the bank above the railroad bridge to be 15 f. from the edge instead of 20 f., on account of a dredge large enough to secure the latter distance not being able to get through the railroad bridge draw, **93**, 1287. Completed, 1898, **98**, 1194.

**Surveys.**

Ordered by act of Mar. 3, 1871, assigned to Maj. Craighill, and made under his direction and the immediate supervision of Capt. Phillips; **71**, 76, 620; **72**, 69, 71, 688.

By J. E. Weyss and G. Thompson, in June and July, 1871, **72**, 707, 708; **73**, 74, 771; **74**, 84; **75**, 92, ii, 121.

Ordered by act of Aug. 11, 1888, made, 1890, under direction of S. T. Abert, **90**, 1097.

Examination made by Lt. Col. Allen, 1897, **97**, 1325.

## ARANSAS BAY, HARBOR, AND PASS, TEX.[a] (See *Aransas Pass and Corpus Christi; Matagorda Bay.*)

**Appropriations.**

| | | |
|---|---|---|
| 1879, | $35,000, | **79**, 111. |
| 1880, | 65,000, | **80**, 1247. |
| 1881, | 80,000, | **81**, 1359. |
| 1882, | 100,000, | **82**, 1471. |
| 1884, | 100,000, | **84**, 1316. |
| 1886, | 101,250, | **86**, 1333. |
| 1888, | 100,000, | **88**, 1308. |
| 1897, | [b] 5,000, | act June 4, 1897. |
| 1899, | 60,000, | **99**, 1972. |
| Total, | 646,250 | |

**Commerce.**

Important, **71**, 531; **79**, 933, 936.
Trade of Corpus Christi, **89**, 1567.
Description of, **98**, 1531, 1549.
See *Projects*.

**Contracts.**

**1881.** F. Brunner, brush, $3.35 per cord; **82**, 1469; C. M. Holdin, stone, **82**, 1469.

**1882.** A. M. Shannon & Co., brush, $2.60; stone, $5 per c. y., **83**, 1092.

**1884.** A. M. Shannon & Co., brush, $2.60; stone, $4.40 per c. y., **85**, 1466.

**1887.** A. M. Shannon & Co., riprap, $2.95 per c. y., **88**, 1308.

**1888.** Charles Clarke & Co., riprap, $2.99 per c. y., **89**, 1565.

**1899.** C. Clarke & Co., dredging, 45 and 80 cents per c. y. ($53,750) **1900**, 2337.

**Engineers.**

Chief of Engineers. Reports, **70**, 31, 62; **71**, 66; **78**, 85; **79**, 111, 112; **80**, 149; **81**, 202; **82**, 199; **83**, 204; **84**, 219; **85**, 229; **86**, 226; **87**, 191; **88**, 175; **89**, 205; **90**, 185; **91**, 235; **98**, 289; **99**, 344, 345; **1900**, 392.

Boards of Engineers:

Ordered to convene at New York July 1, 1879, **79**, 928. Convened by S. O. No. 63, O. C. of E., 1879 (see *Projects*), **80**, 1254.

Convened at New York, July 19, 1887, to report upon the improvement of Aransas Pass. Report, **88**, 1318. (Cols. Casey, Abbot, and Craighill; Lt. Cols. Houston and McFarland, and Maj. King.)

Convened by S. O. 145, dated A. G. O., June 23, 1897, at city of Aransas Pass, Tex., on July 20, 1897, and at Tarpon and Corpus Christi, Tex., on other dates, to ascertain the character and value of improvements made at the pass by the Aransas Pass Harbor Co. Report, **98**, 1527. (Col. H. M. Robert, Maj. Wm. T. Rossell, Capt. John Biddle.)

Constituted by S. O. No. 145, dated June 23, 1897, convened at New York City, Oct. 7, 1898, by S. O. No. 24, dated Oct. 1, 1898 (see *Surveys*). Report, **1900**, 1974. (Col. H. M. Robert and Maj. W. T. Rossell.)

Engineers in Charge:

Maj. C. W. Howell, 1871–79. Reports, **71**, 526; **79**, 928.

Maj. S. M. Mansfield, 1880–86. Reports, **80**, 1245; **81**, 1358; **82**, 1469; **83**, 1091; **84**, 1312; **85**, 1464; **86**, 1330.

Maj. O. H. Ernst, 1886–90. Reports, **87**, 1431; **88**, 1307, 1312; **89**, 1564.

Maj. C. J. Allen, 1890–91. Reports, **90**, 1810; **91**, 1942.

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[a] **Examination.—Report (unfavorable), Apr. 18, 1853. (H. Doc. No. 482, 55th Cong., 2d sess.)**
[b] **For Board to ascertain character and value of improvements of Aransas Pass Harbor Co.**

## ARANSAS BAY, HARBOR, AND PASS, TEX.—Continued.

Maj. J. B. Quinn, 1898. Report, **98**, 1527.

Capt. C. S. Riché, 1899—. Reports, **99**, 1972, 1973; **1900**, 2336..

ASSISTANTS:

Lt. E. A. Woodruff; **71**, 66. Report, **71**, 526.

H. C. Collins, Report, **79**, 934.

H. S. Douglass and W. H. Hoffman; **79**, 934.

T. S. Sedgwick. Report, **80**, 1247.

W. L. Webb. Report, **82**, 1472.

J. E. Savage. Report, **88**, 1308.

G. Bagnall. Report, **89**, 1566.

R. B. Talfor. Report, **1900**, 2337.

**Estimates.** (See also *Plans* and *Projects.*)

By Lt. Woodruff, for cost of 1st plan, $31,794.48; 2d, $49,500; 3d, $688,355.25; 4th, $99,000; 5th, $31,293.90, **71**, 529, 530.

By Maj. Howell, for cost of 1st plan $11,748; 2d, $31,123.40; 3d, $167,222.10 and $198,888.75; 4th, $2,000; 5th, $30,555.50, **79**, 932, 933.

**Legislation.**

Charter of the Aransas Pass Harbor Co., **98**, 1553. Acts of Congress under which the company operated, **98**, 1554, 1556.

The Aransas Pass Harbor Co., 1899, released and surrendered all rights and privileges granted to it in Aransas Harbor by Congress; also the jetties in said harbor, **1900**, 1972.

**Operations.**

**1879–80.** Preliminary work in progress, **80**, 1246.

**1880–81.** Work done with hired labor and open-market purchases; constructing groin jetties for protecting Mustang Island and the south channel jetty, **81**, 202, 1361.

**1881–82.** Constructing jetties with hired labor, **82**, 1469; successful work done, **82**, 199, 1470, 1474.

**1882–83.** Extending south jetty, 1,200 l. f., with 15,476 c. y. brush and 3,474 t. of stone, **83**, 1092.

**1883–84.** Extending jetty to length of 3,900 l. f.; 10,686 c. y. brush and 2,940 c. y. stone used; channel 10½ f. deep at m. l. w. obtained over the bar. **84**, 219, 1314.

**1884–85.** Extending jetty seaward, and raising height with 23,017 c. y. of brush mattress and 4,626 t. of stone; building superstructure with hired labor, over work previously completed; channel 11 f. at m. l. w. obtained over the bar, **85**, 1466.

**1885–86.** With hired labor, repairs made to outer end of south jetty, and trees planted on St. Josephs Island, **86**, 1332.

**1886–87.** Protective work in progress, **87**, 1432.

**1887–88.** Protective work continued; 27,825 c. y. riprap laid protecting 1,895 l. f. of bank; 414,982 s. f. of slope covered; 480 l. f. of spur dike built, **88**, 1311.

**1888–89.** 15,988 c. y. riprap placed in protective work, covering 278,531 s. f. of slope; 205 l. f. of spur built, **89**, 1565.

**1889–90.** Repairs to revetment at head of Mustang Island, **90**, 1811.

**Physical characteristics.**

General, **71**, 527 et seq.; **79**, 929, 934 et seq.; **80**, 1254; **81**, 1360; **98**, 1529.

Rate of movement of bar, **87**, 1431.

Tidal basin and volume of tidal prism at Aransas Pass; depths, surface widths, and areas of cross sections, **88**, 1316.

Description of, Aransas Bay, **91**, 1942.

Table showing variations of depths, widths, and cross sections of the pass, **98**, 1530.

Table indicating that since the building of the jetty the position of the channel apparently more constant and the width across bar lessened, **98**, 1540.

**Plans.** (See *Estimates*, *Private work*, and *Projects.*)

By Lt. Woodruff: (1) for groins of pile work, normal to shore line; (2) for a system of riprap jetties; (3) for a canal from mouth of Turtle Cove to Corpus Christi Bay 4 miles in length, 150 f. wide, and 10 f. deep; (4) for a system of ripraping, building triangular prisms of palm, palmetto, or mangrove from Turtle Cove to the Gulf coast line; (5) for a revetment or jetty on north side of entrance to the canal 1,400 f. long and 10 f. wide, **71**, 529, 530.

By Maj. Howell: (1) for closing Corpus Christi Pass by a dam; (2) for deepening present channel between Corpus Christi Bay and Aransas Pass to a depth of 10 f.; (3) for dredging other channels than the one already in use; (4) for the prevention of drifting of sand off from the lower portion of St. Josephs Island into shoal portions of the Pass; (5) for dredging a channel in Aransas Pass to the depth of 10 f. and width of 100 f., **79**, 930, 931.

**Private (private and corporate) work.**

Work by private enterprise, 1869, for the improvement of the channel by extension of jetties, to cut off secondary channel, and to aid in deepening main channel, **71**, 528; **79**, 930, 937.

Channel between Corpus Christi and Aransas Pass deepened, **79**, 930.

$10,000 subscribed by local interests in 1883 to carry on the work, **84**, 1313; **87**, 1432.

## ARANSAS BAY, HARBOR, AND PASS, TEX.—Continued.

The projects of the Aransas Pass Harbor Co. to secure a depth of 20 feet, but the Board of 1897 found about 9 feet only, **98**, 1537, 1540, 1544.

Projects for improvement, and work done at the pass by other than the Aransas Pass Harbor Co., **98**, 1534. History of the latter company, **98**, 1535. Its plan of improvement, **98**, 1536. Work done by it, which consisted of the construction of two jetties (see engineers' plan, **98**, 1559), and certain auxiliary work in the channel, **98**, 1537; contracts, **98**, 1561–67. Condition of works when examined by Board of 1897, **98**, 1539; effects of, **98**, 1540; cost of, **98**, 1541.

**Projects.** (See *Estimates*, *Plans*, and *Private work.*)

By Maj. Howell: (1) for deepening channel over the bar at the entrance to Aransas Pass with fascines to contract the current and increase its scouring effect; estimated cost, $60,405; (2) for protecting the end of Mustang Island from erosion with matting of fascines ballasted with stones; estimated cost, $126,440, **79**, 930, 931, 932.

By Board of Engineers, 1879, for forming and maintaining a 12-f. channel at m. l. w. over the bar by extending the north jetty from the end of St. Josephs Island, and the south jetty from the end of Mustang Island, and the constructing of groins in conjunction with beach protection for the head of Mustang Island to and beyond Turtle Cove; estimated cost, jetties, groins, etc., $759,185; the improvement of the interior channel from the pass up to Rockport and Corpus Christi to be by dredging; estimated cost (by Maj. Howell), $441,537.75, **80**, 1247, 1254; **81**, 1363; **85**, 1465; **86**, 1330; (by Cols. Tower and Newton and Lt. Col. Gillmore) **80**, 1271. In 1887, the work designed and partly executed having partly failed to obtain the desired result at the pass, Maj. Ernst proposed to abandon as much of the south jetty as curved northward, and by an easy change in direction to the southward to lead the jetty by the shortest line to deep water, the north jetty to be placed parallel to the outer end of the south jetty. To protect Mustang Island it was proposed to riprap its slope from high-water mark to bottom of the channel. The works proposed were expected to secure a channel at least 20 f. deep. Cost of revised project, $2,052,543.72. **87**, 1432.

Congress having, in 1890, granted to the Aransas Pass Harbor Co. the right to improve the navigation of the pass, further operations on the part of the Government were suspended, **90**, 1811.

In 1898 the Board of 1897 was of opinion that the works of the Aransas Pass Harbor Co. for the improvement of the pass were of no value to the Government, **98**, 1544; and showed that if the General Government should take up and complete the works for the improvement of the pass the securities of the company would be practically as valuable as if the improvements had been effected by the company, **98**, 1545.

By Board of Engineers, 1897, to construct two parallel jetties, also to remove a part of the old Government jetty and to dredge to obtain a 20-f. channel 150 f. wide at bottom; estimated cost, $1,525,000, **99**, 1975.

By Capt. Riché, 1900, to expend $40,772.35, remainder of appropriation of 1888, to complete part of north jetty, **1900**, 2336.

**Surveys.**

By Lt. Woodruff, 1870. Reports, **71**, 526, 528.

By H. C. Collins, 1878. Reports **79**, 928, 934.

Minor surveys, **80**, 1258, 1264; **82**, 1470; **83**, 1092; **85**, 1466; **1900**, 2336.

Survey, 1882, by H. C. Ripley and W. L. Webb, **82**, 1470.

Made, 1887, under direction of Maj. Ernst, **88**, 1312.

Examination of Aransas Bay, ordered by act of Sept. 19, 1890; made, 1891, under direction of Maj. Allen (report unfavorable to removing Half-Moon Reef) **91**, 1942.

Sundry civil act of June 3, 1898, provided for a board of engineers to ascertain the character and value of the improvements made at the pass by the harbor company. Report of the board, **1897–98**, 1527.

Plans, specifications, and estimates for improving the harbor, and especially plans and estimates for removing sand bar at the pass, and the deepening of the channel across the bar, to a depth of at least 20 f. and a width of at least 150 f. at bottom, to furnish an inlet for vessels from the Gulf of Mexico, the report to be rendered to say whether the work should be undertaken, called for by joint resolution, May 28, 1898. Board of 1897 reported favorably. **1900**, 1974.

MAPS.

Map of the coast of Texas and maps on enlarged scale of Corpus Christi and Aransas bays and their connections, followed by plans of dam and jetty, **79**, 934; **85**, 1466; **1900**, 2340.

Location of jetties, **87**, 1432.

## ARCADIA, MICH.

**Commerce.**
Description of. Very small and local. **1900**, 3943.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 505; **1900**, 569.

ENGINEER IN CHARGE. Capt. C. Harding, 1899–1900. Report, **1900**, 3942.

ASSISTANT. L. W. Goddard. Report, **1900**, 3944.

**Physical characteristics.**
Description of. Arcadia, a village 18 miles north of Manistee Harbor, having communication with Lake Michigan through Bar Lake, and through a dredged channel (see *Private work*). **1900**, 3943.

**Private work.**
Channel connecting Arcadia with Lake Michigan dredged by private enterprise; cost, about $50,000, **1900**, 3943.

**Survey.**
Examination for a 14-f. channel, 150 f. wide, ordered by act of Mar. 3, 1899, made 1899, under direction of Capt. Harding (report unfavorable), **1900**, 3942.

## ARCHERS HOPE RIVER, VA.

**Appropriations.**
1881, $5,000, **81**, 990.
1882, 5,000, **82**, 842.

Total, 10,000

**Commerce.**
See *Operations*.
Unimportant, **85**, 1034.

**Contracts.**
**1882.** G. W. Ferris, dredging, 37½ cents per c. y., **82**, 1075.
**1883.** J. Caler & Son, dredging, 27½ cents per c. y., **83**, 841.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 159; **82**, 155; **83**, 161; **84**, 165; **85**, 157; **86**, 152; **87**, 117; **88**, 101.

ENGINEERS IN CHARGE.
Capt. C. B. Phillips, 1880–81. Report, **80**, 906.
Capt. J. Mercur, 1881–84. Reports, **81**, 989; **82**, 1074; **83**, 841.
Capt. F. A. Hinman, 1884–87. Reports, **84**, 1031; **85**, 1034; **86**, 962; **87**, 977.
Col. W. P. Craighill, 1888. Report, **88**, 768.

ASSISTANTS.
J. M. Wolbrect. Report, **80**, 907.
G. H. Elliott. Report, **82**, 1075.

**Operations.**
**1881–82.** 12,283 c. y. removed by dredging; no great advantage to commerce resulting from work done, **82**, 1075.
**1882–83.** 16,254 c. y. removed at mouth of river by dredging; limited extent of work of small value to commerce, **83**, 841.

**Physical characteristics.**
Described, **80**, 906.

**Projects.**
By Capt. Phillips, 1880, for channel not less than 50 f. wide and 6 f. deep, mouth to Williamsburg, 5 miles; estimated cost, $19,400.70, **80**, 907; **85**, 157; **87**, 117.

**Surveys.**
Ordered by act Mar. 3, 1879, **79**, 95; made by J. M. Wolbrect. (See *Projects*.) **80**, 907.

## ARCH ROCK. (See *San Francisco, Cal.*)

## ARID REGIONS. (See *Wyoming and Colorado.*)

## ARKANSAS RIVER, ARK., IND. T., AND KANS. (See *Dredges; Mississippi River; Western Rivers.*)

| Part. | Appropriations. |
|---|---|
| A.—Fort Smith and from Fort Smith to Wichita, Kans | $153,000 |
| B.—Pine Bluff, Ark | 131,500 |
| C.—Little Rock to mouth | 19,000 |
| D.—Fort Smith | 18,000 |
| E.—Arkansas and Kansas | 1,030,000 |
| F.—Removing obstructions | 440,875 |
| Total | [a] 1,792,375 |

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[a] See Western Rivers.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part A.—Arkansas River (at Fort Smith and from Fort Smith to Wichita, Kans.). (See *Western Rivers*.)

**Appropriations.**[a]

| | | | |
|---|---|---|---|
| 1876,[b] | $10,000, | **77**, | 80. |
| 1878,[b] | 10,000, | **78**, | 92. |
| 1879,[c] | 20,000, | **79**, | 125. |
| 1880, | 15,000, | **80**, | 1467. |
| 1881, | 24,000, | **81**, | 1510. |
| 1882, | 20,000, | **82**, | 1169. |
| 1886, | 54,000, | **87**, | 1510. |
| Total, | 153,000 | | |

**Commerce.**

Important, **78**, 658; **79**, 126.

**Defense.**

Forts Gibson, Ind. T., and Smith, Ark., in vicinity, **77**, 501; **78**, 658; **79**, 1081, 1082.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **77**, 80; **78**, 92, 93; **79**, 125, 126, 127; **80**, 168; **81**, 215; **82**, 213; **83**, 221; **84**, 229, 232; **85**, 245, 251; **86**, 244; **87**, 205, 1522.

BOARD OF ENGINEERS. Convened at New York, Mar., 1887, to consider the improvement of the Arkansas River. Reports, **87**, 1523, 1527. (Cols. Casey and Abbot, Lt. Cols. Comstock and McFarland.)

ENGINEERS IN CHARGE:

Maj. Charles R. Suter, 1877–78. Reports, **77**, 501; **78**, 658; **79**, 1081, 1085; **80**, 1466; **81**, 1660.

Capt. T. H. Handbury, 1881–83. Reports, **81**, 1508; **82**, 1576; **83**, 1168.

Maj. M. B. Adams, 1883–84. Reports, **84**, 1397, 1399, 1405.

Capt. H. S. Taber, 1884–87. Reports, **85**, 1561, 1611; **86**, 1391; **87**, 1510, 1519, 1520.

ASSISTANTS:

Capt. D. W. Wellman, **78**, 658. Report, **78**, 659.

J. H. Curtis, **78**, 658.

J. D. McKown, **79**, 1085. Report, **79**, 1086.

**Obstructions.**

Bridges not provided with draws, **79**, 1085.

**Operations.**

**1877–78.** 1,800 f. of dike constructed, including 100 f. of shore protection, **78**, 660.

**1878–79.** Dike extended 400 f., strengthened and repaired, **79**, 1081.[d]

**1879–80.** Repair of dike at Fort Smith, **80**, 1467.

**1880–81.** Constructing snag boat, **81**, 1509.

**1881–82.** Operating snag boat between mouth of Grand River and Fort Smith, **82**, 1577. Repairs to dike at Fort Smith, **82**, 1578.

**1882–83.** 1,047 snags and trees and 20 piles of drift removed between mouth of Grand River and Fort Smith, **83**, 1169.

**1883–84.** 2,890 snags and trees and 2 drift piles removed, **84**, 1399.

**1884–85.** 1,399 snags and trees removed, **85**, 1562.

**1886–87.** Dike construction at Dardanelle; commencement of operations below Little Rock under project of 1886, **87**, 1512, 1519.

**Physical characteristics.**

General description, **79**, 1086–1088.

Bar obstructing free access to city landing at Fort Smith, **77**, 501.

Change in river due to construction of dikes, **78**, 661.

Rocks and snags in channel, **79**, 1085–1087.

Erosion of river bank in front of Fort Smith and bar formation at Van Buren, **84**, 1397.

**Private (corporate) work.**

Construction of 3 jetties by the Oil and Compress Co. at Fort Smith **84**, 1397.

**Projects.**

By Maj. Suter, for improvement of river at Fort Smith, with dike of brush and stone, extending 1,100 f. out from left bank, and from its outer end, a longitudinal dike, 600 f. in length, extending downstream; thus to force main channel toward right bank, so, by deepening the crossing over the bar, to render the city landings accessible, **78**, 658. To widen, raise, and strengthen dam at Fort Smith, to give a uniform height of 8 f. above mean low water, **78**, 658; success of this project, **79**, 1082. For removal of rocks, snags, and other obstructions from the river generally, at an estimated cost, originally, of $900,000, subsequently reduced to $100,000, **79**, 1081, 1086, 1088; **81**, 215.

By Capt. Taber, 1885, for the permanent improvement of the river from Little Rock to its mouth, contemplating a channel at least 200 f. wide and 6 f. deep at low water, by the contraction and regulation of the channel; estimated cost, $2,538,544, **85**, 1603; **87**, 1524.

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[a] $100,000 also appropriated, 1832–68. (See *Western Rivers*.)

[b] Allotted from appropriation for improvement of the Mississippi, Missouri, and Arkansas Rivers.

[c] Fort Smith to Wichita, Kans., **79**, 125.

[d] Method of constructing dikes, **78**, 659, 660.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part A.—Arkansas River (at Fort Smith and from Fort Smith to Wichita, Kans.)—Continued.

**Surveys.**

Under directions of Maj. Suter, 1877, **78,** 659.

By J. D. McKown, 1878, an examination of Arkansas River from Fort Smith, Ark., to mouth of Little Arkansas River at Wichita, Kans. Report, **79,** 1085, 1086.

Survey from Wichita, Kans., to Fort Gibson, Ind. T., 1884, **84,** 232; **85,** 1611, **86,** 1391.

Maps. Plans for brush dike, **78,** 658. Map of Arkansas River at points of improvement, **78,** 660.

### Part B.—Arkansas River at Pine Bluff, Ark.

**Appropriations.**

1880, $25,000, **80,** 1467.
1881, 23,000, **81,** 1503.
1882, 20,000, **82,** 1576.
1884, 55,500, **84,** 229.
1886, 8,000, **86,** 1376.

Total, 131,500

**Engineers.**

Chief of Engineers. Reports, **80,** 168, 169; **81,** 214; **82,** 212; **83,** 220; **84,** 229, 1394; **85,** 245; **86,** 238; **87,** 205.

Engineers in Charge:

Maj. C. R. Suter, 1879–81. Reports, **80,** 1467, 1468.

Capt. T. H. Handbury, 1881–83. Reports, **81,** 1502; **82,** 1575; **83,** 1168.

Maj. M. B. Adams, 1883–84. Reports, **84,** 1393, 1395.

Capt. H. S. Taber, 1884. Reports, **85,** 1564, 1576; **86,** 1376; **87,** 1511, 1515, 1518.

Assistants:

Capt. T. H. Handbury. Report, **80,** 1468.

W. H. Byram. Report, **81,** 1504.

E. F. Officer. Report, **85,** 1571.

T. P. Adams. Report, **85,** 1580.

**Operations.**

**1880–81.** 7,600 l. f. of bank revetted in front of city and at Yell's Bend; 1,110 l. f. of wire curtain dike placed in channel 2½ miles above city, **81,** 1502.

**1881–82.** 3,000 l. f. of bank revetted at Yell's Bend, **82,** 1576.

**1882–83.** 3,000 l. f. of bank regraded, 2,400 f. of low-water and 1,000 f. of high-water protection placed, **83,** 1168.

**1884–85.** Construction of two deflecting dikes, **85,** 1567. Dikes described, **85,** 1571, 1581.

**1885–86.** Construction of two short deflecting hurdle dikes in front of Pine Bluff City, **86,** 1375.

**1886–87.** Extension of dike No. 1, **87,** 1516. Successful results, **87,** 1517.

**Physical characteristics.**

Danger from cut-off at Pine Bluff, **80,** 1469. Erosion of bank in vicinity of, **80,** 1469; **84,** 1395; **85,** 1565. Formation of river banks, **84,** 1395. Effect of freshet in 1884, **85,** 1565, 1567.

**Plans.**

By Maj. Adams, 1884, after failure of previous project, to protect Pine Bluff City by (1) formation of cut-off 3 miles from the city, at estimated cost of $37,732; (2) by mattress protection, at estimated cost of $45,000; (3) by pile jetties 1,500 f. long, at estimated cost of $55,000, **84,** 1396.

**Projects.**

By Maj. Suter, 1880, for the improvement of the river in the vicinity of Pine Bluff, by the protection of river bank from erosion, rectification of the river just above, and prevention of a cut-off across the peninsula opposite Pine Bluff; estimated cost, $100,000, **80,** 1468, 1470. Failure of project, **84,** 1395; **85,** 1565; **87,** 1515.

By Capt. Taber, 1884, to protect the threatened destruction of the city front by two deflecting dikes of piles, brush, and sand boxes; the upper dike 1,520 f. and the lower dike 251 f. long; cost about $49,000, **85,** 1567, 1571, 1581.

**Surveys.**

Ordered by act of Mar. 3, 1879, **79,** 127; **80,** 169; made under direction of Maj. Suter, 1879, **80,** 1468.

Maps, **81,** 1504; **85,** 1570.

### Part C.—Arkansas River, Little Rock to mouth.

**Appropriation.**

1884, $19,000, **85,** 1603.

**Engineers.**

Chief of Engineers. Reports, **85,** 251; **86,** 244; **87,** 206.

Engineer in Charge. Capt. H. S. Taber, 1884–87. Reports, **85,** 1601; **86,** 1389; **87,** 1528.

Assistant. C. E. Taft. Report, **85,** 1604.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part C.—Arkansas River, Little Rock to mouth—Continued.

**Physical characteristics.**
Described, **85**, 1605.

**Plans.**
By Capt. Taber, 1885, to obtain a channel 200 f. wide and 6 f. deep at low water, Little Rock to the mouth, by the contraction of the channel, with primary and secondary hurdles; estimated cost $2,538,544 (see *Projects, Arkansas River, Ark.*), **85**, 1603.

**Surveys.**
From Little Rock to its mouth, **85**, 1601; **86**, 1389; **87**, 1529.

### Part D.—Arkansas River, at Fort Smith, Ark.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1884, | $5,000, | **85**, | 1563. |
| 1886, | 13,000, | **87**, | 205. |

Total, 18,000

**Engineers.**
CHIEF OF ENGINEERS. Reports, **85**, 245; **87**, 205.

ENGINEERS IN CHARGE.
Maj. M. B. Adams, 1884. Report, **84**, 1397.
Capt. H. S. Taber, 1884–87. Reports, **85**, 1563; **87**, 1511, 1518.
ASSISTANT. F. D. Lewis, **85**, 1564.

**Operations.**
History of previous operations, **85**, 1563.
**1884–85.** Extension of jetty previously built by private enterprise, **85**, 1564.
**1886–87.** 1,300 l. f. of permeable dike completed, **87**, 1511.

**Physical characteristics.**
Erosion of river bank at Fort Smith, **84**, 1397.

**Private work.** (See *Operations; Projects.*)

**Projects.**
In 1878 Maj. Suter, for a brush and stone dike at Fort Smith, 1,100 f. long, extending from the left bank and near the mouth of Poteau River; completed in 1879, at a cost of $19,695, **78**, 658; **79**, 1082; **85**, 1563.
In 1884 Maj. Adams proposed repairing a few small dikes built by private enterprise, **84**, 1397; **85**, 1563.

### Part E.—Arkansas River, Ark. and Kans.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $150,000, | **88**, | 1385. |
| 1890, | 180,000, | **90**, | 1939. |
| 1892, | 250,000, | **92**, | 1680. |
| 1894, | 250,000, | **95**, | 2011. |
| 1896, | 100,000, | **96**, | 1666. |
| 1899, | 100,000, | **99**, | 2034. |

Total, 1,030,000

**Commerce.**
Prospective advantages to commerce to result from completed improvement, **88**, 1384, 1388; **90**, 1937; **91**, 2041.
Description of, **94**, 1538, **95**, 2010, **96**, 1665.
Probable increase in future importance of, **93**, 2107, **94**, 1539.
The river has but small influence on freight rates, **96**, 1665.
The commerce for 1900 was 75,654 tons, valued at $2,078,940, **1900**, 417.

**Contracts.**
**1895.** H. J. George & Co., subsistence supplies, $10,067.02. Dickinson Hardware Co., ship supplies, $4,208. Z. Ward, jr., brush, poles, and piles, $3,661.50; stone, $9,085. **95**, 2003, 2011.
**1896.** H. J. George Grocer Co., subsistence supplies, $3,696.51, **97**, 1969.
**1899.** M. A. Sweeney Shipyard and Foundry Co., steel snagboat, $44,000; steel hull, $22,500. B. B. Rogers, stone, $1 per c. y. ($9,285). T. Lafferty, 9,285 c. y. stone at 59 cents per c. y. **1900**, 2583.

**Engineers.**
CHIEF OF ENGINEERS. Reports **88**, 186; **89**, 219; **90**, 197; **91**, 250; **92**, 241; **93**, 272; **94**, 252; **95**, 281; **96**, 244; **97**, 311, 316; **98**, 302, 308; **99**, 363; **1900**, 416.

BOARDS OF ENGINEERS:
Convened at New York, March 16, 1888, to report upon improvement of the river from Wichita, Kans., to its mouth. Report, **88**, 1389. (Cols. Casey and Abbot, Lt. Cols. Comstock and Houston, and Maj. King.)
Constituted by S. O., No. 13, dated March 11, 1899, to examine and report upon a project for the work on Arkansas River; examination in progress, **1900**, 2581.

ENGINEERS IN CHARGE:
Capt. H. S. Taber, 1884–93. Reports, **88**, 1380, 1386; **89**, 1647; **90**, 1932; **91**, 2037; **92**, 1676; **93**, 2103.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part E.—Arkansas River, Ark., and Kans.—Continued.

Capt. C. F. Palfrey, 1894. **94**, 1531.

Lt. Wm. L. Sibert, 1895-98—Reports, **95**, 1998; (Capt.) **96**, 1652, **97**, 1952, 1989, 1990; **98**, 1649, 1676.

Lt. Robert McGregor, 1899—. Reports, **99**, 2033; (Capt.) **1900**, 2581.

ASSISTANT:

P. R. Van Frank, jr. Reports, **94**, 1540; (steamboating on the river before the days of railroads), **1900**, 2585.

**Operations.**

**1887-88.** 2,594 l. f. of dike built between Little Rock and the mouth, **88**, 1383.

**1888-89.** Dike construction and repairs to existing dike at Pine Bluff; 2,000 l. f. of dike built at Dardanelle; spur dike built at Van Buren; dike construction at Baring Cross Bridge, and at and below Little Rock, **89**, 1649.

**1889-90.** Dike construction and repair at Pine Bluff; 1,500 l. f. of dike built above Fort Smith; 300 l. f. of dike built near Wilsons Rocks; construction of 3 dikes begun below Pine Bluff; 2 quarter boats and 10 barges built, **90**, 1932.

**1890-91.** 800 l. f. of dike built above Fort Smith and 2 dikes partially completed; 260 c. y. rock removed at Morris Rocks; 3,257 l. f. of dike built below Pine Bluff; 10 barges built, and repairs made to plant, **91**, 2040.

**1891-92.** 800 l. f. of stone and brush dike completed above Fort Smith; 926 c. y. rock excavated at Morris Rocks; 8,376 c. y. rock quarried at Big Rock Stone Quarry; 300 l. f. of dike built at Pine Bluff; 1 mile of brush mattress, 125 to 150 feet wide, laid and riprapped below Pine Bluff; repair and construction of plant, **92**, 1678.

**1892-93.** Over 15 old dikes solidified, and new ones built; nearly 15,000 c. y. rock quarried and used in the foregoing work; banks revetted; 20 barges built, and plant repaired, **93**, 2105.

**1893-94.** Solidifying of permeable dikes and other such structures continued; several new dikes built; nearly 7,000 c. y. stone quarried and used in the foregoing work and in revetment of banks; pile-driving barge built and plant repaired, **94**, 1534.

**1894-95.** A small quantity of obstructions removed, and several dikes, training wall, dam, etc., built; nearly 8,000 l. f. revetment built; plant repaired, **95**, 2001.

**1895-96.** Over 400 snags removed; several dikes, training wall, etc., built; nearly 10,000 l. f. revetment constructed; existing works repaired; additions made to plant and the plant repaired, **96**, 1655.

**1896-97.** Over 19,000 snags and other obstructions removed; work carried on for the construction of nearly 20 dikes, dams, training walls, etc.; repairs of several structures made; large amount of dredging done; banks protected; plant repaired and additions made, **97**, 1953.

**1897-98.** Obstructions removed; 8 secondary channels closed; 3 wing dams built; revetment constructed at several points, and repairs to such work made at other places; a few low-water chutes closed; plant repaired, **98**, 1649.

**1898-99.** Boats repaired, and 217 snags removed from channel, **99**, 2033.

**1899-1900.** Boats repaired, 5 dikes, and Greathouse and Reed bends repaired, **1900**, 2585.

**Physical characteristics.**

Description of, **94**, 1537; **95**, 2007; **96**, 1664; **97**, 1953; **98**, 1656.

The bed and banks to a great extent composed of sandy loam, eroding easily; as a result the channel continually changing, caving banks wearing away, and opposite-point bars building out, **95**, 2009.

Gauge readings (from 1872-97), **95**, 2010; **96**, 1664; **98**, 1662.

In 1897 the filling up of the harbor and caving of banks at Van Buren, and the caving of banks in the vicinity of Little Rock and Dardanelle appeared to be caused by natural agencies and not by works of improvement (see *Surveys* and *Projects*), **97**, 1989; **98**, 1676.

Description of, in the vicinity of Dardanelle, **98**, 1677.

Discharge, **98**, 1656, 1664; **1900**, 2587.

Channel depths of crossings above Little Rock; comparison of, with unimproved portions of the river, **98**, 1657.

Effects of flood on Trial Reach, just above Little Rock, **98**, 1658.

Flood of May, 1898, damaged constructed works, **1900**, 417.

**Plans.**

By Board of Engineers, 1888, for improvement of the river from Canadian River to its mouth, a distance of 1,409 miles, giving a navigable depth of 4 feet at m. l. w. by contraction work, shore protection, and removal of obstructions; estimated cost, $16,360,000, **88**, 1400.

**Private work.**

In 1897, 7,110 l. f. bank protection, etc., were built by the St. Louis Southwestern R. R. Co., at a cost of $30,477.19, the plant of the Government being loaned for the work, **97**, 1958, **98**, 1652.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part E.—Arkansas River, Ark. and Kans.—Continued.

**Projects.** (See *Plans.*)

In 1878 Maj. Suter proposed a brush-and-stone dike at Fort Smith 1,100 feet long, extending from the left bank near the mouth of Poteau River; completed in 1879 at a cost of $19,695, **78**, 658; **79**, 1082; **85**, 1563.

In 1879 Maj. Suter proposed removal of snags, rock, and other obstructions between Fort Smith and Wichita Bar; estimated cost, $100,000, **79**, 1081, 1088; **81**, 215.

In 1884 Maj. Adams proposed repairing a few small dikes built by private enterprise, **84**, 1397; **85**, 1563.

By Capt. Taber, 1885, for the permanent improvement of the river from Little Rock to its mouth, contemplating a channel at least 200 feet wide and 6 feet deep at low water, by the contraction and regulation; estimated cost, $2,538,544, **85**, 1603; **87**, 1524.

In the general improvement of the river as proposed in 1885, special works of protection and contraction were provided for at Pine Bluff, Fort Smith, and Dardanelle, **88**, 1380, 1381.

In 1889 the amount required for completion was increased from $2,344,544 to $3,651,479, **89**, 1651; **92**, 1679.

The act of 1892 provided for expending two-fifths of the appropriation of 1892 on the river from its mouth to Little Rock, two-fifths from thence to Fort Smith, and one-fifth above the latter point; applied to solidifying permeable dikes, etc. (see *Operations*), **93**, 2105.

From August 29, 1896, the estimate for completing the improvement of the river reported not determinable, **97**, 1953.

Results of the works for permanent improvement apparently favorable, **93**, 2106, 2107; **97**, 1967.

In 1897 (see *Surveys*) it was reported that the dikes and bank protection at Pine Bluff did not injure the river banks or harbor, but had preserved the city from destruction, **97**, 1991.

Cost of the works from 1894 to 1898, **98**, 1656.

Approved project, 1888, to remove rock and gravel reefs by blasting and dredging, to contract the channel by dikes or dams, permeable or solid, of such construction as the local conditions require, and to hold the channel so obtained by revetment where necessary; the project to include the river from Wichita, Kans., to the mouth, 771 miles; cost, indefinite, **1900**, 416.

**Surveys.**

Minor surveys, **93**, 2106; **94**, 1535; **98**, 1649; **99**, 2033.

Surveys of the river at Little Rock, Van Buren, Fort Smith, Pine Bluff, and at Dardanelle ordered by act of June 3, 1896, to ascertain what injuries had been caused by Government works of improvement in the vicinity of the places named, and what steps should be taken to guard against or remedy such injuries. Report by Capt. Sibert in 1897, **97**, 1989–1991; **98**, 1676.

MAPS. **90**, 1934; **92**, Atlas, 83, 84, 85; **95**, 2012; **1900**, 2584.

### Part F.—ARKANSAS RIVER, removing snags and wrecks. (See *Western Rivers.*)

**Appropriations.**[a]

| | | | |
|---|---|---|---|
| 1880,[b] | $200,000, | **80**, | 1404. |
| 1881, | 25,000, | **81**, | 1501. |
| 1882, | 35,000, | **82**, | 1574. |
| 1884, | 36,000, | **84**, | 228. |
| 1886, | 19,875, | **86**, | 1373. |
| 1888, | 25,000, | **88**, | 1380. |
| 1890, | 20,000, | **90**, | 1931. |
| 1892, | 20,000, | **92**, | 1675. |
| 1894, | 20,000, | **95**, | 1998. |
| 1896, | 20,000, | **96**, | 1651. |
| 1899, | 20,000, | **99**, | 2032. |
| Total, | 440,875 | | |

**Commerce.**

Important, **84**, 1391; **86**, 1374, 1390; **87**, 1508.

Prospective advantages from completion of improvement, **88**, 1379; **89**, 1646; **91**, 2036.

Much benefited by works of improvement, **94**, 1530.

Commerce, 1900. (See Part E, *Arkansas River.*)

**Contracts.**

**1895.** J. E. Joyce & Co., subsistence supplies for snagging party, $2,142.91; Dickinson Hardware Co., boat supplies, $2,560. **95**, 1998.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 162; **81**, 213; **82**, 211; **83**, 219; **84**, 227; **85**, 244; **86**, 238; **87**, 204; **88**, 185; **89**, 218; **90**, 196; **91**, 249; **92**, 241; **93**, 272;

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[a] $80,000 appropriated, 1832–37. (See *Western Rivers.*)

[b] For removing snags and wrecks from Arkansas, Mississippi, and Missouri rivers.

## ARKANSAS RIVER, ARK., IND. T., AND KANS.—Continued.

### Part F.—Arkansas River, removing snags, etc.—Continued.

**94**, 251; **95**, 280; **96**, 244; **97**, 310; **98**, 302; **99**, 362; **1900**, 415.

ENGINEERS IN CHARGE:

Maj. C. B. Suter, 1880–81. Report, **80**, 1401.

Capt. T. H. Handbury, 1881–83. Reports, **81**, 1499; **82**, 1571; **83**, 1165.

Maj. M. B. Adams, 1883–84. Report, **84**, 1390.

Capt. H. S. Taber, 1884–93. Reports, **85**, 1558; **86**, 1371; **87**, 1506; **88**, 1378; **89**, 1643; **90**, 1928; **91**, 2033; **92**, 1673; **93**, 2102.

Capt. C. F. Palfrey, 1894. Report, **94**, 1529.

Lt. Wm. L. Sibert, 1895–98. Reports, **95**, 1995; (Capt.) **96**, 1649; **97**, 1949; **98**, 1647.

Lt. Robert McGregor, 1899—. Reports, **99**, 2031; (Capt.) **1900**, 2577.

ASSISTANT: P. R. Van Frank, jr. Report, **1900**, 2579.

**Operations.**

**1879–80.** 500 miles of river between mouth and Trustee Bend worked over; 1,238 snags and trees and 19 drift piles removed, **80**, 1403.

**1880–81.** 2,377 snags and trees and 44 drift piles removed between mouth and Webbers Falls, **81**, 1500.

**1881–82.** 4,436 snags and trees and 18 drift piles removed between mouth and Fort Smith, **82**, 1572.

**1882–83.** 1,287 snags and 12 drift piles removed between mouth and Fort Smith, **83**, 1166.

**1883–84.** 654 snags and 9 drift piles removed, **84**, 1390.

**1884–85.** 15,178 snags and trees and 19 drift piles removed between mouth and Fort Gibson, **85**, 1559.

**1885–86.** Repair of snag boat *Wichita*, **86**, 1372.

**1886–87.** 1,385 snags removed, **87**, 1508.

**1888–89.** Reconstruction of snag boat *Wichita*, **89**, 1644.

**1889–90.** 552 snags and 231 overhanging trees removed, **90**, 1929.

**1890–91.** 300 snags removed from the channel, 2,000 trees cut, and 13,000 trees deadened upon the banks, **91**, 2034.

**1891–92.** 787 snags removed, 544 overhanging trees cut away, and 4 drift piles destroyed, **92**, 1674.

**1892–93.** Snag boat under construction, and about 1,500 snags and other obstructions removed, **93**, 2102.

**1893–94.** Over 1,600 snags, etc., removed, **94**, 1530.

**1894–95.** Over 3,500 snags, etc., removed, **95**, 1997.

**1895–96.** Over 1,500 snags, etc., removed, **96**, 1650.

**1896–97.** About 200 snags, etc., removed, **97**, 1950.

**1897–98.** Nearly 15,000 snags, etc., removed, **98**, 1648.

**1898–99.** 134 snags and other obstructions removed from the channel, **99**, 2031.

**1899–1900.** About 7,400 snags and other obstructions removed from the channel, **1900**, 2580.

**Physical characteristics.**

Condition of the stream steadily improving, **94**, 1530.

**Surveys.**

From Little Rock to mouth, **85**, 1601.

## AROOSTOOK RIVER, ME.

**Commerce.**

Local, **74**, ii, 327.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 106; **74**, 116; **79**, 52; **80**, 72.[a]

ENGINEER IN CHARGE. Lt. Col. George Thom, 1872–79, **73**, 106; **74**, 116; **79**, 52. Report, **74**, ii, 327.

ASSISTANT. S. Haagensen, **74**, ii, 327. Report, **74**, ii, 328.

**Physical characteristics.**

Description of, **74**, ii, 327, 329.

Water stages, **74**, ii, 328.

Navigation limited to a short period of the year by obstructions at low water, **74**, ii, 328.

**Obstruction.**

Obstructions, list of, **74**, ii, 330, 331.

**Plans.**

By Lt. Col. Thom, for a channel 50 feet wide by 2 feet deep at low water, from the international boundary to Masardis, 69 miles, $50,000, **74**, ii, 327, 328, 329, 330.

**Surveys.**

By S. Haagensen, 1872, **73**, 106; **74**, 116, ii, 327, 328.

Ordered from international boundary to Masardis, 1878, **79**, 52.

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[a] Printed in House Ex. Doc. No. 84, 43d Cong., 1st sess.

## ARREARAGES, ETC. (See *Examinations, etc.*)

## ARROW ROCK, MO. (See *Missouri River between mouth and Sioux City.*)

## ARTHUR KILL, N. J. AND N. Y. (See also *Staten Island, New Jersey channel.*)

**Appropriations.**

1888, $10,000, **89**, 820.
1890, 7,000, **90**, 845.
1892, 5,000, **92**, 870.
1894, 4,500, **95**, 970.

Total, 26,500

**Commerce.**

Description of, **93**, 1084, **1900**, 1526.

**Contracts.**

**1890.** R. G. Packhard, dredging, 23½ cents per c. y., **90**, 844.

**1891.** Atlantic Dredging Co., dredging, 24½ cents per c. y., **91**, 985.

**1892.** Atlantic Dredging Co., dredging, 24 cents per c. y., s. m. ($4,000), **93**, 1106.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 86; **90**, 76; **91**, 97; **92**, 100, 398; **93**, 105, 108; **94**, 97; **95**, 109; **99**, 164; **1900**, 188.

BOARD OF ENGINEERS:

Convened at New York City, May 20, 1892, by S. O. No. 49, to consider the modification of the pier-head line established March 4, 1890, on Arthur Kill, in front of Perth Amboy. Report, **92**, 861.

(Cols. Abbot, Craighill, and Houston, and Lt. Col. Gillespie.)

ENGINEERS IN CHARGE:

Capt. T. L. Casey, 1889–94. Reports, **89**, 819; **90**, 843; **91**, 983; **92**, 869; **93**, 1104; **94**, 798.

Lt. Col. G. L. Gillespie, 1895 (see *Surveys*). Report, **95**, 969.

Col. J. W. Barlow, 1899. Reports, **1900**, 1525, 1527.

ASSISTANT: C. S. Kelsey. Report, **1900**, 1529.

**Operations.**

**1889–90.** 29,000 c. y. dredged, **90**, 844.

**1890–91.** 22,000 c. y. dredged, **91**, 984.

**1892–93.** 16,500 c. y. dredged, **93**, 1105.

**1894–95.** 7,738 c. y. dredged; project completed, **95**, 969.

**Physical characteristics.**

Description of, **93**, 1083; **1900**, 1530.

**Projects.**

By Capt. Casey, 1888, for removal of a point of land near the Staten Island Bridge, to straighten the channel, and facilitate the passage of long tows through the drawspan of the bridge; estimated cost, $26,500, **89**, 86, 820.

Col. Barlow estimated, 1899, it would cost $696,000 for a 21-f. channel, 300 to 400 f. wide, from Kill van Kull to Raritan Bay, with $5,000 annually for maintenance, **1900**, 1529.

**Surveys.**

An examination for a channel west of Robbins Reef light-house was ordered by act of July 13, 1892, made, 1892, by Lt. Col. Gillespie (report unfavorable), **93**, 1083.

Examination and survey of Arthur Kill, from Kill van Kull to Raritan Bay, ordered by act of March 3, 1899, made, 1899–1900, under direction of Col. Barlow (report favorable). (See *Projects.*) **1900**, 1525, 1527.

MAPS. **89**, 820; **90**, 844.

## ARTHUR LAKE, LA. (See *Mermentau River.*)

## ASHEPOO RIVER, S. C. (See *Mosquito Creek* and *Santee River.*

**Appropriation.**

1872, $1,300, **73**, 69.

**Contract.**

**1872.** With J. Griffin, removing obstructions, **73**, 733.

**Engineers.**

CHIEF OF ENGINEERS. Report, **73**, 69.

ENGINEER IN CHARGE. Maj. Q. A. Gillmore, **73**, 69. Report, **73**, 733.

**Operations.**

**1872–73.** Small schooner and a large quantity of logs and piles removed, to give low-water depth of 10 f., **73**, 69, 733.

**Projects.**

For removal of obstructions placed in the channel during civil war, **73**, 733.

## ASHEPOO RIVER, S. C., below the Charleston and Savannah Railroad Bridge.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 158.

ENGINEER IN CHARGE. Capt. F. V. Abbot, 1889. Reports, **89**, 1216, 2796.

**Obstructions.**

Bridge obstructing navigation, **89**, 2796.

**Surveys.**

Examination ordered by act of August 11, 1888, made, 1888, under direction of Capt. Abbot (report unfavorable), **89**, 1216.

## ASHLAND HARBOR, WIS.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1886, | $22,500, | **86**, | 449. |
| 1888, | 60,000, | **88**, | 1818. |
| 1890, | 60,000, | **90**, | 2296. |
| 1892, | 45,000, | **92**, | 2139. |
| 1894, | 25,000, | **95**, | 2556. |
| 1896, | 27,000, | **96**, | 2353. |
| 1899, | 35,000, | **99**, | 2704. |
| Total, | 274,500 | | |

**Commerce.**

Necessity for breakwater protection to wharves and piers, **85**, 2011.

Increase in staple exports, **89**, 2016; **90**, 2296.

Description of; probability of increase of; principal shipments, iron ore and lumber, **93**, 2675; **98**, 2241.

Increasing in the easterly part of the town, **97**, 2604.

From 1886 to 1899, commerce valued at $355,000,000; **1900**, 3593.

**Contracts.**

**1889.** H. Steele, breakwater construction, $11.45 per running f., **89**, 2017.

**1891.** H. Steele, breakwater construction, $25.95, and brush and stone dike construction, $6.25 per running f., **91**, 2501.

**1893.** H. Steele, pier repairs, $4,500, **94**, 2025.

**1895.** Ashland Brownstone Co., furnishing stone, $4.19 per cord. P. F. Ferguson, furnishing slabs, $1.50 per cord. **95**, 2556.

**1896.** A. & D. Sang, stone, $4.37 per cord, **97**, 2605.

**1897.** C. S. Barker, dredging, 11 cents per c. y., **97**, 2605.

**1900.** Hugo & Tims, breakwater extension, $20,976, **1900**, 3594.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 206; **85**, 307; **86**, 301; **87**, 256, 1960; **88**, 233; **89**, 270; **90**, 244; **91**, 313; **92**, 299; **93**, 340; **94**, 311; **95**, 347; **96**, 303, **97**, 388; **98**, 380; **99**, 451; **1900**, 516.

BOARD OF ENGINEERS:

Constituted by S. O. No. 35, to report upon project for improvement of Ashland Harbor. Report, **87**, 1961. (Maj. Allen, Capt. Lockwood, and Capt. Marshall.)

ENGINEERS IN CHARGE:

Lt. Col. Robert, 1880, **80**, 1929.

Lt. Col. Barlow, 1884–86. Reports, **85**, 2010, 2012; **86**, 1674.

Capt. C. E. L. B. Davis, 1887–89. Reports, **87**, 1957; (Maj.) **88**, 1817.

Maj. J. B. Quinn, 1889–91. Reports, **89**, 2015; **90**, 2295.

Capt. W. L. Fisk, 1891–92. Reports, **91**, 2500; **92**, 2137.

Maj. C. B. Sears, 1893–. Reports, **93**, 2674; **94**, 2023; **95**, 2554; **96**, 2352; **97**, 2603; **98**, 2240; **99**, 2703; **1900**, 3592.

ASSISTANTS:

L. Y. Schermerhorn. Report, **80**, 1930.

H. N. Babcock. Report, **86**, 1676.

**Operations.**

**1888–89.** 100 l. f. of breakwater built, **89**, 2015.

**1889–90.** 4,550 l. f. of breakwater built, **90**, 2295.

**1890–91.** Extension of breakwater in progress under contract, **91**, 2500.

**1891–92.** Breakwater completed to a total length of 5,680 f.; breach in Chequamagon Point closed by a brush and stone dike 4,200 f. long; repairs to the old portion of the breakwater, **92**, 2138.

**1892–94.** 600 l. f. of breakwater work completed; **93**, 2674; **94**, 2024.

**1894–95.** Breakwater repaired, **95**, 2555.

**1896–98.** 110,073 c. y. dredged and deposited in the breakwater; **97**, 2603; **98**, 2240.

**1899–1900.** About 91 f. shore arm breakwater built under project of 1899 before passage of act of 1900 (see *Projects*). Breakwater construction on new site begun. **1900**, 3592.

**Physical characteristics.**

Described, **80**, 1930; **86**, 1677; **93**, 2674; **98**, 2240.

The turbulence of the waters of the harbor much diminished by the construction of the breakwater, **93**, 2674; **94**, 2024.

Storms damaging works, **94**, 2024; **95**, 2555; **96**, 2352.

New site for breakwater, 1900, rocky; **1900**, 3592.

## ASHLAND HARBOR, WIS.—Continued.

**Plans.**

By Lt. Col. Barlow, 1885, for pile and slab breakwater, about 8,000 f in length, about 2 miles northeast of the ore dock, at an estimated cost of $132,377, and removing, by dredging to a depth of 12 f., the shoal in front of Mueller & Ritchie's wharf, at an estimated cost of $10,000, **85**, 2013; **86**, 1675.

**Private (City and Railroad) Work.**

Harbor lines established by the city of Ashland, **93**, 2674; **94**, 2024; **95**, 2555.

A railroad company owning ore docks at the city authorized to place dredged material dredged from its docks against the breakwater, **96**, 2352; **97**, 2604.

**Projects.**

By Board of Engineers, 1887, for improvement of Ashland Harbor by closing the breach in Chequamagon Point with a pile revetment 4,300 f. long, and by dredging a channel 100 f. wide and 18 f. deep in front of and touching the principal wharves of the city, with a semicircular turning basin of 400 f. radius; estimated cost $83,540, **87**, 1966; **88**, 1817, 1818. This project was abandoned in 1889, at the request of the citizens of Ashland, and a new project was submitted by Maj. Quinn and approved by the Board of Engineers. This provided for dredging a channel along the piers 200 f. wide and 17 f. deep, and the construction of 4,650 l. f. of breakwater projecting into the bay in such a manner as to protect the wharves from wave action; the inner end of the breakwater to be 1,000 f. outside of the established dock line. Estimated cost, $247,967.50. **89**, 2015, 2016.

In 1890, after completion of the breakwater as projected, the project was modified to provide for the excavation of the channel along the wharves at an estimated cost of $103,125, **90**, 2295, 2296; also the construction of 2,320 l. f. of breakwater extension, making the total estimated cost for completion of proposed improvements in 1891, $187,500, **91**, 2500; **92**, 2138.

By Maj. Sears, 1892, for expending the appropriation of 1892 in extending the breakwater 1,000 f. at the inner end to partly fill the gap between the old work and the shore, and about 680 f. at the outer end of the old work, **93**, 2674; and in 1896 for expending the appropriation of 1896 in strengthening the breakwater and dredging a 16-f. channel along the dock line parallel thereto and about 150 f. therefrom, **96**, 2352.

Act of Mar. 3, 1899, practically added 2,200 f. to original project for 8,000-f. breakwater. Maj. Sears proposed, 1899, to apply the appropriation of 1899 to building as much as possible of shore end of breakwater from the shore in line of prolongation of old work; $10,000, however, to be expended in repair of old work, **99**, 2703.

Act of June 6, 1900, provided that in lieu of building shore end of breakwater there should be substituted a breakwater beginning about 2,600 f. east of the point at which the existing shore arm of the breakwater would meet the shore if prolonged, and running in direction parallel to existing breakwater for 4,700 f. or for such length as might be necessary to protect the harbor, **1900**, 3592.

**Surveys.**

Ordered by act of Mar. 3, 1879, **79**, 155.

By H. N. Babcock, 1885, **86**, 1676.

Harbor lines established by Secretary of War in 1896 (see *Private work*), **96**, 2353; **97**, 2604; **98**, 2241.

MAPS. **89**, 2016.

## ASHLEY RIVER, S. C.

**Appropriations.**

1880, $1,000, **80**, 933.
1881, 1,500, **81**, 1068.
1884, 2,000, **84**, 1098.
1886, 1,000, **86**, 1082.

Total, 5,500.

**Commerce.**

Local, **73**, 756.

Commerce of the river, **88**, 984.

In 1892–93 the freight moved on the river amounted to 465,000 tons, **93**, 1512, and in 1893–94 to 525,000 tons, **94**, 1115.

**Contracts.**

**1882.** Charleston Dredging Co., dredging, 17 cents per c. y., **82**, 1140.

**1885.** Ross & Sanford, dredging, 20 cents per c. y., **86**, 1082.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 70; **80**, 127; **81**, 170; **82**, 166; **83**, 175; **84**, 182; **85**, 180; **86**, 179; **87**, 142; **88**, 136, **89**, 151; **90**, 136; **91**, 176; **92**, 174; **93**, 188; **94**, 172; **95**, 197; **99**, 292.

ENGINEERS IN CHARGE:

Lt. Col. Q. A. Gillmore, 1873–87, **73**, 70. Reports, **73**, 756; **80**, 932; **81**, 1067;

## ASHLEY RIVER, S. C.—Continued.

**82,** 1138; **83,** 892; **84,** 1097; **85,** 1188; **86,** 1080; **87,** 1141.

Capt. F. V. Abbot, 1888–95. Reports, **88,** 983; **89,** 1166; **90,** 1205; **91,** 1476; **92,** 1229; **93,** 1512; **94,** 1114; **95,** 1433.

ASSISTANTS:

Capt. B. D. Greene. Reports, **81,** 1068, **82,** 1140.

Lt. F. V. Abbot. Report, **85,** 1190.

J. P. Allen. Report, **93,** 1513.

**Estimates.** (See *Projects.*)

By Maj. Gillmore, for dredging 25,000 c. y., $10,000, **73,** 756.

**Operations.**

**1881–82.** No previous operations; 13,558 c. y. dredged, opening a channel across the shoal at the Wando Phosphate Works 100 f. wide and 11 f. deep, **82,** 1139.

**1885–86.** 8,566 c. y. dredged from shoal near Stono Phosphate Island in the formation of a channel 210 f. wide and 11 f. deep at mean low water, **86,** 1081.

**1886–87.** Available funds held until condition of improved channel requires further expenditure, **87,** 142, 1141.

**1892–93.** 4,001 c. y. were dredged, and the project completed, **93,** 1512.

**Physical characteristics.**

Description of, **73,** 756.

**Projects.** (See *Estimates.*)

By Lt. Col. Gillmore, 1873, for a dredged channel 11 f. deep at mean low water across shoals of Accabee and the Wando Phosphate Works, at an estimated cost of $5,000, **73,** 756; **86,** 179; **87,** 1141.

**Surveys.**

Survey completed, 1873, **73,** 70, 756.

Stadia survey of upper river, **88,** 983.

## ASHTABULA HARBOR, OHIO.[a] See *Black River* (Lorain); *Conneaut,* and *Fairport harbors.*

**Appropriations.**

| | | |
|---|---|---|
| 1826, | $12,000.00, | **66,** iii, 32. |
| 1828, | 2,403.50, | **66,** iii, 32. |
| 1829, | 6,940.25, | **66,** iii, 32. |
| 1831, | 7,015.00, | **66,** iii, 32. |
| 1832, | 3,800.00, | **66,** iii, 32. |
| 1833, | 3,400.00, | **66,** iii, 32. |
| 1834, | 5,000.00, | **66,** iii, 32. |
| 1835, | 7,591.00, | **66,** iii, 32. |
| 1837, | 8,000.00, | **66,** iii, 32. |
| 1838, | 8,000.00, | **66,** iii, 32. |
| 1844, | 5,000.00, | **66,** iii, 32. |
| 1852, | 10,000.00, | **66,** iii, 32. |
| 1853, | 42.64, | **66,** iii, 32. |
| 1859, | 809.65, | Act, Feb. 9. |
| 1866, | 24,708.82, | **66,** iii, 32. |
| 1867, | 54,000.00, | **67,** 140. |
| 1871, | 15,000.00, | **71,** 195. |
| 1872, | 15,000.00, | **72,** 232. |
| 1873, | 16,000.00, | **73,** 44. |
| 1874, | 35,000.00, | **74,** 51. |
| 1875, | 25,000.00, | **75,** 56. |
| 1876, | 5,000.00, | **76,** ii, 562; **77,** 115. |
| 1878, | 12,000.00, | **78,** 130, 1265. |
| 1879, | 9,000.00, | **79,** 1702. |
| 1880, | 20,000.00, | **80,** 2164. |
| 1881, | 20,000.00, | **81,** 2325. |
| 1882, | 20,000.00, | **82,** 2411. |
| 1884, | 22,500.00, | **84,** 2117. |
| 1886, | 30,000.00, | **86,** 1872. |
| 1888, | 25,000.00, | **88,** 2014. |
| 1890, | 40,000.00, | **90,** 2786. |
| 1892, | 70,000.00, | **92,** 2510. |
| 1894, | 75,000.00, | **95,** 3116. |
| 1896, | 50,000.00, | **96,** 2964. |
| 1899, | 50,000.00, | **99,** 3068. |
| 1900, | 110,000.00, | **1900,** 4079 |
| Total, | 823,210.86. | |

**Commerce.**

Rapidly increasing, **79,** 1702.

Increase in tonnage from 1884 to 1890, **91,** 2864.

The development of the harbor as a shipping point for ore and coal thought remarkable, the amount of such freight handled in 1892 being about 4,500,000 tons, **93,** 3087; in 1893–94 the port was considered the greatest shipping point on the lake for coal and ore, **94,** 2422; **97,** 3087; **98,** 2681; **99,** 3069.

Would be greatly benefited by completion of breakwaters, **1900,** 4078.

**Contracts.**

**1866.** K. McKenzie, and J. Loveday, materials and labor, **67,** 232, 233.

**1868.** R. R. Dodge, dredging sand, $0.30; rock, $1.20, **69,** 140; **70,** 179.

**1871.** Lee & Dunbar, blasting and dredging rock, $2.25; **71,** 195; **72,** 232; $2.75 and $0.50; **73,** 341.

**1872.** Lee & Dunbar, dredging sand, $0.35, **73,** 341.

**1873.** F. A. Seymour, drilling, blasting, and dredging rock, $2.00 and $0.50, **74,** 223. **73,** 341.

**1874.** Hemenway & Garfield, materials and labor. Cartwright, McCurdy & Co., iron. **75,** 314.

**1875.** Case & Jennings, drilling, blasting, and dredging rock and sand, $1.80 and $0.50, **75,** 315; **76,** ii, 562.

**1877.** Charles H. Strong, materials and labor. W. H. McCurdy, iron. **77,** 967.

**1878.** Kenneth McKenzie, timber and labor. Pratt & Co., iron. **79,** 1704. K. McKenzie, crib construction, **80,** 2166

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[a] Survey.—Report, July 14, 1826, estimate, $12,000 (H. Doc. No. 482, 55th Cong., 2d Sess.).

## ASHTABULA HARBOR, OHIO—Continued.

**1879.** Cleveland, Brown & Co., iron. Hemenway & Hayes, crib construction, **80**, 2166; contract annulled as to principals and continued by bondsmen, **81**, 2324.

**1880.** J. Barnett, iron; G. W. and A. T. McKenzie, materials and work; J. Caldwell, materials and work; F. Wilson, iron; D. B. McCoy, dredging, 20 cents per c.·y., **81**, 2324, 2327.

**1883.** G. B. Rasher, dredging, 30 cents per c. y., **84**, 2115.

**1884.** McKenzie & Barrett, dredging and pier construction, **85**, 2244.

**1886.** L. P. & J. A. Smith, dredging and pier construction, **85**, 2244.

**1887.** Carkin, Stickney & Cram, rock removal and dredging, **87**, 2331.

**1888.** Carkin, Stickney & Cram, rock excavation, $1.90 per c. y., **89**, 2332. B. S. Horton, pier extension and repair, $8,920, **89**, 2333.

**1890.** Q. Gillmore, pier extension and repair, $9,733.12, **90**, 2783.

**1892.** Carkin, Stickney & Cram, removal and rebuilding pier, and pier extension; total, $61,056.20, **93**, 3088.

**1893.** Sadler & Allen, dredging, 20 cents per c. y., s. m., **93**, 3088.

**1895.** Carkin, Stickney & Cram, rock excavation, 97 cents per c. y., furnishing dredging plant, $10 per hour, $28,857, **95**, 3116.

**1897.** L. P. & J. A. Smith, breakwater construction; $43,139.63, **97**, 3088.

**1899.** E. J. Hingston, dredging, 20 cents per c. y. (circular letter), **99**, 3069.

**1900.** Donnelly Contracting Co., constructing breakwaters of stone and pierheads of timber, stone, and concrete, $407,410, **1900**, 4083.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, iii, 32, iv, 13; **67**, 30; **68**, 42; **69**, 38; **70**, 49; **71**, 47; **72**, 47; **73**, 44; **74**, 51; **75**, 56; **76**, 108; **77**, 115; **78**, 130; **79**, 173; **80**, 227; **81**, 311; **82**, 306; **83**, 314; **84**, 318; **85**, 342; **86**, 337; **87**, 302; **88**, 276; **89**, 327; **90**, 296; **91**, 372; **92**, 351; **93**, 402; **94**, 376; **95**, 411, 413; **96**, 366; **97**, 460; **98**, 450; **99**, 533; **1900**, 600.

BOARD OF ENGINEERS:

Convened at Cleveland, Ohio, Oct. 25, 1899, under S. O. No. 55, dated Oct. 6, 1899, to consider and report on the use of stone in breakwaters for the harbors of Black River, Ashtabula, Conneaut, and Fairport, Ohio, **1900**, 4084. Report, **1900**, 4086.

(Col. J. A. Smith, Maj. C. B. Sears, Maj. T. W. Symons.)

ENGINEERS IN CHARGE:

Maj. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess.

Col. T. J. Cram, 1866–67. **66**, ii, 41. Reports, **66**, iv, 10; **67**, 230, 233.

Maj. W. McFarland, 1868–70. Reports, **68**, 159; **69**, 139; **70**, 179.

Maj. G. L. Gillespie, 1871–72. **71**, 189. Reports, **71**, 195; **72**, 232.

Maj. F. Harwood, 1873–74. **73**, 42. Reports, **73**, 340; **74**, 223.

Lt. Col. C. E. Blunt, 1874–77. **74**, 215. Reports, **75**, 314; **76**, ii, 562; **77**, 963.

Maj. W. McFarland, 1878. Report, **78**, 1264.

Maj. J. M. Wilson, 1878–82. Reports, **79**, 1700; (Lt. Col.) **80**, 2155; **81**, 2322; **82**, 2409.

Maj. M. B. Adams, 1882–83. Report, **83**, 1917.

Capt. E. Maguire, 1883–85. Report, **84**, 2113.

Maj. L. C. Overman, 1885–92. Reports, **85**, 2240; **86**, 1871; **87**, 2327; **88**, 2013; **89**, 2329; **90**, 2783; **91**, 2863.

Lt. Col. J. A. Smith, 1892—. Reports, **92**, 2508; **93**, 3085; **94**, 2420; **95**, 3113, 3122; **96**, 2959; (Col.), **97**, 3086; **98**, 2679; **99**, 3068; **1900**, 4075, 4084.

ASSISTANTS:

Capt. F. U. Farquhar, **66**, ii, 41, iv, 10, 11.

W. T. Blunt. Report, **95**, 3126.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Graham, for 22 cribs, repairs and dredging, to complete the work, $38,015.56. S. Doc. 42, 35th Cong., 1st sess.

By Col. Cram, for completion of work, $54,000 additional, **66**, iii, 4, 32, iv, 12.

For entire and permanent improvement, completion, $78,464, **66**, iv, 73.

By Capt. Farquhar, for repairs of piers and dredging, $20,753.91; for pier extension, $57,710.28, **66**, iv, 11, 12.

By Maj. McFarland, for completion of the work, $2,073.98, in addition to Col. Cram's estimate; for widening channel 30 f. or 40 f., $15,000, **68**, 159, 160; **69**, 140; **70**, 180.

By Maj. Gillispie, for annual repairs, $800, **71**, 195; **72**, 232.

By Maj. Harwood, for extension of west pier 500 feet, and dredging, $65,000; repairs to piers, $6,000; prolonging channel, $9,000, **73**, 340. For completion of work, $45,000, **74**, 223.

By Lt. Col. Blunt, for completion of work, $20,000, **75**, 314.

By Maj. Wilson, for completion of existing project, $50,000, **79**, 173, 1702.

**Obstructions.**

Examination by Board of Engineer officers of dumping in the river by Pennsylvania Co., **99**, 3069.

**Operations.**

**1852–55.** Repairs and extension of piers, S. Doc. 42, 35th Cong., 1st sess.

**1866–67.** Contracts for piers let, **67**, 140.

## ASHTABULA HARBOR, OHIO—Continued.

**1867–68.** Repairs and extension of piers; 8 cribs, a total of 240 f., placed, **68,** 159, 160.

**1868–69.** Completion of pier, 12 cribs, and superstructure built; dredging, **69,** 139, 140.

**1869–70.** Blasting and dredging completed; channel 60 f. wide, **70,** 179.

**1871–72.** Removal of 4,505 c. y. solid rock, and 3,436 c. y. loose stone and sand. Channel widened 30 f. and 13 f. deep. **72,** 232.

**1872–73.** Removal of 9,306 c. y. rock, and 4,212 c. y. sand, **73,** 44.

**1873–74.** Blasting and dredging; channel from harbor to lake, 60 f. wide, 14 f. deep, **74,** 223.

**1874–75.** Extension of west pier by 9 cribs, 270 f.; 10,455 c. y. of sand removed from bar; 400 f. of sand-catch fence built, **75,** 314.

**1875–76.** Extension of west pier 190 f.; channel, 100 f. by 14 f., **76,** ii, 562.

**1876–77.** Repairs to piers and dredging, by open purchase and day labor, **77,** 967.

**1877–78.** Repairs to piers by hired labor. Extension of west pier by contract, **78,** 130, 1264.

**1878–79.** Repairs to piers, extension of east pier 80 f., and dredging, **79,** 173, 1701.

**1879–80.** 120 l. f. of substructure and 202 l. f. of superstructure built; extensive repairs to west and minor repairs to east piers; 7,989 c. y. dredged from shoal at entrance to harbor, **80,** 2162, resulting in the formation of a channel depth between the piers of from 14½ to 16 f., with a channel of entrance from 15 to 17 f. deep, **80,** 227.

**1880–81.** East and west piers each extended 200 l. f.; 4,433 c. y. dredged from bar at entrance to piers, resulting in the formation of a channel from 15 to 17 f. deep, **81,** 2323, 2324.

**1881–82.** West pier extended 403 f. and east pier 121 f.; 5,447 c. y. removed from channel and repairs made to piers.

**1882–83.** 7 crib substructures built and ready to place in position, **83,** 1918.

**1883–84.** Extension of west pier shoreward 285 l. f.; 2,968 c. y. dredged from channel; repair of east pier by hired labor, **84,** 2114.

**1884–85.** Extension of west pier shoreward 282½ l. f.; repairs to east pier and to shore protection at inner end of west pier; 17,173 c. y. dredged from the channel and bank in rear of old pier; a channel 15½ f. deep was obtained from deep water outside, **85,** 2240.

**1885–86.** 400 l. f. of shore end of west pier removed and 380 l. f. of same partially revetted; slight repairs by hired labor to shore protection, **86,** 337, 1871.

**1886–87.** 8,483 c. y. of sand dredged from bar and channel; repair of old piers; rock removal from channel commenced, **87,** 2328.

**1887–88.** 12,731 c. y. dredged, **88,** 2013.

**1888–89.** 2,414 c. y. dredged; extension of east pier and repairs to both piers begun, **89,** 2330.

**1889–90.** 2,800 c. y. dredged; extension of east pier completed, **90,** 2784.

**1890–91.** 2,957 c. y. ledge rock and 4,101 c. y. loose rock, sand, and gravel removed from the channel, **91,** 2864.

**1891–92.** 24,000 c. y. dredged, **92,** 2509.

**1892–93.** Extension of east pier in progress, and 1,189 c. y. dredged, **93,** 3086.

**1893–94.** In connection with previous year 242 f. of old east pier was torn out and reconstructed, and the east and the west were each extended 240 f., **94,** 2420. Renewal of superstructure of west pier in progress, **94,** 2421.

**1894–95.** Renewal of superstructure of west pier completed, **95,** 3114.

**1895–96.** 24,179 c. y. rock and 22,375 c. y. of other material removed, **96,** 2960.

**1896–97.** About 24,000 c. y. rock and other material removed, **97,** 3086, and construction of west breakwater commenced, **97,** 3086.

**1897–98.** A portion of the west breakwater constructed, **98,** 2680, and 4,860 c. y. dredged, gauge readings made, and repairs made to small storehouse (drawings), **98,** 2681.

**1898–99.** Breakwater lines laid out on ice; soundings made through ice; 18,152 c. y. dredged, **99,** 3068.

**1899–1900.** Over 1,000 c. y. dredged, **1900,** 4077.

**Physical characteristics.**

Described, **67,** 140; **70,** 181; **93,** 3123; **97,** 3087; **98,** 2681.

Advance of outer bar proportionate to pier extension, **82,** 2410.

Advantage taken, 1899, of the heavy ice formation to lay out breakwater lines and to make soundings along its situation, **99,** 3068.

Formation of bars checked slightly by small section of breakwater in existence in 1899, **99,** 3069.

Bar formation, **1900,** 4077.

**Plans.** (See *Estimates* and *Projects.*)

By Col. Cram, for repairs to piers, ignoring the "flare," and carrying them parallel with each other to 12-f. curve, and dredging 7,329 c. y. of sand, and 7,158 c. y. of shale work, **66,** iv, 13; **67,** 140; **69,** 140.

By Maj. McFarland, for blasting and dredging channel from 60 f. to full width between the piers, about 100 f., **70,** 1

## ASHTABULA HARBOR, OHIO—Continued.

By Maj. Gillespie, for blasting and dredging channel to 14 f. in depth, $15,000, **72,** 232.

By Maj. Harwood, for extension of west pier 500 f. to 14 f. depth of water, repairing piers, and lengthening channel by blasting and dredging, **73,** 340; **74,** 223; **75,** 314.

By Lt. Col. Blunt, for repairs to piers and dredging, $5,000, **77,** 967.

By Maj. Wilson, for extension of west pier 400 l. f. and east pier 600 l. f., **79,** 1701.

**Private (corporate) work.**

A part of the old east pier, 116 f. long, was removed in 1893–94 by the Lake Shore and Michigan Southern R. R. Co., **94,** 2420, and 380 f. in 1896–97, by authority of the Secretary of War, **97,** 3086.

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Wilson, 1880, for the further extension of the piers to the 16-f. curve, with the removal of 1,100 l. f. of old west pier, revetting the river bank, and the removal by dredging of 20,000 c. y. of material, at an estimated cost of $88,000, **80,** 2163. In 1882 Lt. Col. Wilson estimated that $62,000 would be required, in addition to the $60,000 appropriated since 1880, to complete the work, **82,** 2410; impossible to maintain a depth at entrance to pier of 16 f. without continual dredging, **82,** 2411.

In 1883 Maj. Adams increased the foregoing estimate to $91,800, **83,** 1918.

In 1884 Maj. Maguire increased previous estimate to $102,750, **84,** 2117; **85,** 342.

In 1890 Maj. Overman proposed securing 20 f. depth by extension of the piers to the 22-f. curve in the lake, involving the construction of 1,360 l. f. of pier, with repairs to existing works; estimated cost, $265,650, **90,** 2785.

In 1891 Maj. Overman proposed the removal of 242 l. f. of the lake end of the east pier and relocation of the same 45 f. to the eastward of its present position, with additional rock excavation as required by such change of pier; estimated cost, $23,492, making the total cost of revised and approved project $329,142, **91,** 2864.

Lt. Col. Smith, 1892–93, revised the estimated cost, making it $225,000, **93,** 3086.

By Lt. Col. Smith, 1896, for 2 breakwaters converging toward the lake, 400 f. apart at the outer ends, to be protected by pierheads, the west breakwater to be 1,800 f. long and the east breakwater 1,200 f. long, exclusive of the pierheads; estimated cost, $530,000, **95,** 3125, **96,** 2963.

By Col. Smith, 1899, for channel maintenance by dredging with an allotment of $5,000, **99,** 3068.

Change made in project of 1896 to provide for breakwaters of stone, with timber crib pierheads (drawings), **1900,** 4076.

Existing works badly in need of repair, 1900; estimated cost, including restoration, maintenance, etc., for one year, $205,520, **1900,** 4078.

Description of breakwaters of stone recommended by Board of 1899 (drawings), with estimates of cost of the various types, **1900,** 4086.

**Surveys.**

Under direction of Lt. Col. Raynolds, by W. T. Casgrain, 1865, **66,** iv, 10; **67,** 140.

Under direction of Maj. Wilson, 1879, **79,** 1901.

Survey to determine what improvement should be made with a view to constructing a harbor of refuge, and to enlarging the capacity of the port for the purposes of commerce, ordered by act of Aug. 17, 1894, made under the direction of Lt. Col. Smith, 1895, **95,** 3122.

Minor surveys, **93,** 3085; **98,** 2681; **1900,** 4077.

MAPS.

**81,** 2324; **84,** 2116; **91,** 2866; **94,** 2422; **95,** 3126; **96,** 2964.

Of harbors of northern and northwestern lakes, showing location of this harbor, **66,** 24.

## ASSATEAGUE BAY, DEL. (See *Chincoteague Bay to Delaware Bay.*)

## ASSONET RIVER, MASS.

**Commerce.**

Description of, **1900,** 1301.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900,** 111.

ENGINEER IN CHARGE. Maj. D. W. Lockwood, 1900. Report, **1900,** 1300.

**Physical characteristics.**

Description of, **1900,** 1301.

**Surveys.**

Examination ordered by act of Mar. 3, 1899, made by Maj. Lockwood, 1899 (report unfavorable), **1900,** 1301.

## ASTORIA, OREG. (See *Columbia River*.)

## ATCHAFALAYA BAY AND RIVER, LA. (See *Charenton Canal; Grand Lake; Mississippi River; Plaquemine* and *Teche bayous*).

**Commerce.**

Important, **71,** 68, 557; **74,** 74, 775, 776.

Tributary to the improvement, **85,** 1432, 1434, 1439; 1899.

Large falling off attributed to shortage of crops, **1900,** 2284.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71,** 67; **73,** 66; **74,** 74; **80,** 146; **81,** 197; **82,** 193; **84,** 216; **85,** 226; **89,** 202; **97,** 291; **1900,** 383.

ENGINEERS IN CHARGE:

Capt. C. W. Howell, 1870–82; **71,** 66; **73,** 66; **74,** 74. Reports, **71,** 554; **74,** 771; (Maj.) **82,** 1394.

Maj. H. Stickney, 1882–85. Reports, **82,** 1393; **84,** 1285.

Capt. T. Turtle, 1885. Report, **85,** 1436.

Maj. W. H. Heuer, 1885. Report, **85,** 1432.

Capt. W. L. Fisk. Report, **89,** 1510.

Maj. J. B. Quinn, 1897–1900. Reports, **97,** 1779; **1900,** 2283.

Maj. H. M. Adams, 1900. Report, **1900,** 2284.

ASSISTANTS:

G. Dyes, **71,** 67. Report, **71,** 555.

F. P. Leavenworth. Report, **71,** 771.

Lt. O. T. Crosby. Report, **85,** 1436.

J. L. Brownlee. Report, **97,** 1780.

P. H. Thomson. Report, **1900,** 2286.

**Estimates.**

By G. Dyes, channel 100 f. by 12 f. $104,800; 150 f. by 12 f. $122,300; 200 f. by 12 f. $140,300, **71,** 554.

By Capt. Howell, removing obstructions to Courtableau Bayou, $14,000, **74,** 776.

**Physical characteristics.**

Description of, **74,** 771, 772, 773; **82,** 1395; **97,** 1780; **1900,** 2286.

Table of distances, etc., **74,** 771,772.

A channel, beginning about 3 miles outside of the river mouth and extending through the bay to deep water in the Gulf, about 12½ miles; average width, 100 f.; depths, 7 and 10 f.; the latter, for one-fifth of the distance, was created before 1896 by the Morgan Steamship Co., **97,** 1780.

Winds and tides, **1900,** 2286.

**Plans.**

**1874.** Of F. P. Leavenworth, to remove snags, trees, etc., channel to mouth of the Courtableau, 60 miles, **74,** 775, 776.

**Private (corporate and State) work.**

The river formerly cleared of logs by State of Louisiana, **82,** 1396.

Morgan's Steamship Co. excavated, 1870–74, a 12-f. channel from deep water in the Atchafalaya River to the 12-f. contour in the Gulf of Mexico, **71,** 68, 554.; **1900,** 2286.

**Projects.**

In 1882 Maj. Stickney reported the improvement so intimately connected with the Mississippi that no recommendations could be made until the Mississippi River Commission should act, **82,** 1410. Concurred in, 1885, by Maj. Heuer, **85,** 1435.

In 1884 Capt. Turtle submitted an estimate of $20,000 for provisional work, **85,** 1433.

Maj. Adams estimated, 1900, it would cost $1,939,399.08 to make the desired improvement, **1900,** 2285.

**Surveys.**

By G. Dyes, 1870, **71,** 67, 555.

Ordered from mouth of Red River down the Atchafalaya to Brashear, 1873, **73,** 66; completed by F. P. Leavenworth, 1874, **74,** 74, 771.

Under direction of Maj. Howell, river from Berwicks Bay to mouth of Red River, 1880, **82,** 1394.

By Capt. Turtle, 1885, river from Berwicks Bay to Red River (report favorable), **85,** 1432.

Examination of river, ordered by act of Aug. 11, 1888, made, 1888, under direction of Capt. Fisk (report unfavorable), **89,** 1510.

Examination to ascertain the nature and character of the channel through the bay and its value to the United States, ordered by act of June 3, 1896, made, 1897, under direction of Maj. Quinn (report unfavorable), **97,** 1779.

Examination and survey of Atchafalaya Bay from the mouth of Atchafalaya River to deep water in the Gulf of Mexico, with a view to obtaining a channel 12 f. deep, m. l. w., 200 f. wide, with an estimate of cost of said improvement, ordered by act of Mar. 3, 1899; examination made, 1899, by Maj. Quinn (report favorable); survey made, 1900, under direction of Maj. Adams (report unfavorable) (see *Projects*), **1900,** 2283, 2284.

## ATCHAFALAYA RIVER. (See *Red River, Ark., La., and Tex.*)

## ATCHISON, KANS. (See *Missouri River between mouth and Sioux City.*)

## ATLANTIC AND MISSISSIPPI WATER COMMUNICATION. (See *Mississippi to Atlantic.*)

## ATLANTIC CITY HARBOR (ABSECON INLET), N. J.

**Appropriation.**

1886, [a]$5,000, **87**, 814.

**Commerce.**

Necessity for harbor of refuge on the New Jersey coast, **81**, 831; **85**, 862; **87**, 816.

Important, 1898, **98**, 1126, 1130.

**Engineers.**

Chief of Engineers. Reports, **80**, 98; **81**, 129; **85**, 127; **87**, 85; **88**, 85; **95**, 133; **98**, 158.

Board of Engineers:

Constituted by S. O., No. 141, O. C. of E., 1886, to examine and report upon a harbor of refuge at Atlantic City. Report, **87**, 815.

(Lt. Cols. Comstock, Robert, and McFarland.)

Engineers in Charge:

Capt. W. Ludlow, 1881. Report, **81**, 831.

Maj. W. H. Heuer, 1885. Report, **85**, 862.

Lt. Col. H. M. Robert, 1886–88. Reports, **87**, 814; **88**, 717.

Maj. C. W. Raymond, 1890–98. Reports, **95**, 1094; **98**, 1125.

Assistants:

G. Daubeney. Report, **81**, 832.

L. d'Auria. Report, **87**, 819.

R. G. Pearson. Report, **98**, 1129.

**Physical characteristics.**

Absecon Inlet, **81**, 831; **85**, 863; **87**, 817; **95**, 1094.

Tidal and current observations, **81**, 833; **87**, 815, 819.

**Plans.**

By Maj. Heuer, 1884, for an improved entrance to the deep water inside of Absecon Inlet by means of a south jetty, starting from the beach below the lighthouse, and a north jetty from Brigantine Beach, converging to a width of entrance of about one-fourth of a mile in water 18 f. deep; estimated cost of jetties, $960,000; the work not considered a public necessity, **85**, 862–864.

By Board of Engineers, 1887, for a harbor of refuge in the inner harbor by the construction of a channel of entrance across the outer bar, having a low-water depth of 20 f.; the channel to be attained by the construction of two converging jetties of random stone, with a superstructure of concrete above the plane of low water; estimated cost of jetties, $3,000,000. If the entire amount of material to be removed from channel between the jetties should require to be dredged, the cost of the improvement would be increased by $600,000. **87**, 817, 818.

**Projects.**

Maj. Raymond estimated, 1898, it would cost $500,000 to improve Absecon Inlet, **98**, 1128.

**Surveys.**

Ordered by act of Mar. 3, 1879, made under direction of Capt. Ludlow, 1880, **80**, 97; **81**, 831.

Ordered by act of Aug. 5, 1886, made under direction of a Board of Engineers, 1876, **87**, 815.

Examination of the locality inside of the inlet ordered by act of Aug. 17, 1894, made by Maj. Raymond, 1894 (report unfavorable), **95**, 1094.

Survey ordered by act of June 3, 1896, made under direction of Maj. Raymond, 1898 (see *Projects*), **98**, 1126.

Maps. **87**, 818.

## ATLANTIC COAST. (See *Dredges and Snagboats; Transportation Routes.*)

## ATLANTIC FRONTIER, MILITARY DEFENSES. (See *Albemarle Sound.*)

## ATLANTIC OCEAN. (See *Albemarle Sound; Dismal Swamp Canal; Florida Canal; Mississippi River; Norfolk Harbor.*)

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[a] Survey.

## ATLANTIC OCEAN TO THE GULF OF MEXICO (canal between).[a]

(See *Mississippi River.*)

**Appropriations.**[a]

| | |
|---|---|
| 1826, | $20,000 |
| 1830, | 10,400 |
| 1852, | 20,000 |
| Total, | 50,400 |

## AUCILLA AND WACISSA RIVERS, FLA. (See *Wacissa and Aucilla rivers, Fla.*)

**Commerce.**
None, **80**, 1302.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 141; **81**, 189; **82**, 185.

ENGINEER IN CHARGE. Capt. A. N. Damrell, 1880–82. Report, **82**, 1302.

ASSISTANT. P. Robinson. Report, **82**, 1303.

**Physical characteristics.**
Natural bridge across river, **82**, 1302.

**Plans.**
In 1881 Capt. Damrell reported that the removal of obstructing logs could be accomplished for $500 if done in connection with the improvement of the Aucilla River, **82**, 1303.

**Survey.**
Ordered by act of June 14, 1880, made under direction of Capt. Damrell, **82**, 1302.

## AU GRES RIVER, MICH.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 319.

ENGINEER IN CHARGE. Col. O. M. Poe, 1889. Report, **89**, 2277.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Col. Poe (report unfavorable) **89**, 2277.

## AUGUSTA. (See *Kennebec River, Me.*, *Savannah River, Ga.*)

## AUSABLE HARBOR AND RIVER, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1867, | $50,000, | **67**, 147. |
| 1869,[b] | 2,970, | **69**, 22. |
| 1870, | 15,000, | **70**, 45. |
| 1871, | 10,000, | **71**, 176. |
| 1872, | ·10,000, | **72**, 207. |
| 1876, | 1,000, | **77**, 933. |
| 1879, | 7,000, | **79**, 169, 1657. |
| 1880, | 7,000, | **80**, 2039. |
| 1881, | 6,000, | **81**, 2247. |
| 1882, | 5,000, | **82**, 2331. |
| Total, | 113,970 | |

**Commerce.**
Not unimportant, **66**, iii, 34; iv, 76, 90.
Increase, **69**, 109; **70**, 153.

**Contracts.**

**1867.** Caskin & Kimball, materials and labor, **67**, 232, 233; **68**, 152.

**1870.** Caskin & Kimball, superstructure, **70**, 159.

**1871.** W. H. Patten, superstructure. Forfeited, **71**, 176; **72**, 205.

**1879.** J. R. Worden, revetments, **80**, 2037, 2039.

**1880.** C. Southerland, pile and slab revetment, **81**, 2245.

**1881.** Carkin, Stickney & Crane, dredging, 26 cents per cubic yard, **81**, 2247.

**1889.** Carkin, Stickney & Cram, dredging, 34½ cents per cubic yard, **89**, 2248.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **66**, ii, 41, iii, 8, 34, 70; **67**, 27; **68**, 37; **69**, 22, 34; **70**, 43; **71**, 43; **72**, 40; **74**, 46; **75**, 51, 53; **76**, 104, 106; **77**, 110; **78**, 128; **79**, 169; **80**, 220; **81**, 298; **82**, 292;

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[a] Reports of surveys rendered Feb. 19, 1829, Mar. 6, 1832, May 1, 1855. Report (favorable) of examination made Apr. 3, 1876. Survey made 1880; report dated Apr. 6, estimated that about $50,000 would be required. (H. R. Doc. 482, 55th Cong., 2d sess.)

[b] Allotment.

## AUSABLE HARBOR AND RIVER, MICH.—Continued.

**83,** 302; **84,** 304; **85,** 327; **86,** 321; **87,** 298; **88,** 263; **89,** 311, 319; **90,** 279; **91,** 351; **92,** 336.

ENGINEERS IN CHARGE:

Maj. W. F. Raynolds, 1866. Report, **66,** iv, 76, 90.

Col. T. J. Cram, 1867–69. Reports, **67,** 147, 149, 157, 230, 233; **68,** 141, 151, 152; **69,** 107.

Maj. W. McFarland, 1870, **70,** 150.

Maj. O. M. Poe, 1870–72. Reports, **70,** 150, 160, 162; **71,** 175; **72,** 204.

Maj. G. Weitzel, 1873–77. Reports, **73,** 291; **74,** 201; **75,** 272, 286; **76,** ii, 531, 550; **77,** 932.

Maj. F. Harwood, 1878–83. Reports, **78,** 1229; **79,** 1657, S. Doc. 70, 45th Cong., 3d sess.; **80,** 2037; **81,** 2245; **82,** 2330.

Maj. F. N. Farquhar, 1883, **83,** 1835.

Lt. Col. O. M. Poe, 1883–92. Reports, **83,** 1854; **84,** 2040; **85,** 2130, 2132; **86,** 1825; **87,** 2250; (Col.) **88,** 1962; **89,** 2247, 2279; **90,** 2723; **91,** 2771; **92,** 2453.

ASSISTANTS:

Capt. G. J. Lydecker, **68,** 151.

H. G. Rothwell, **69,** 109; **72,** 205. Reports, **75,** 272, 287.

Capt. A. N. Lee. Reports, **74,** 202; **77,** 932.

H. A. Ulffers. Report, **76,** ii, 550.

B. H. Muehle. Report, **83,** 1857.

**Estimates.** (See *Plans* and *Projects.*)

By Col. Cram, 1867, for 10 feet depth of water, $69,367, **67,** 147. For completion, $20,000, and $6,000 annually for dredging, **68,** 141.

By Maj. Poe, for annual dredging, $3,000, **70,** 153. For continuing the work, $20,000, **72,** 206.

By Maj. Weitzel, 1876, for break-water off the mouth of the harbor, $900,000, **76,** ii, 550.

By Maj. Harwood, 1879, for restoration and completion of harbor, $35,000, **79,** 1657. Revised to $25,000, **79,** 1658.

**Legislation.**

Discussion of existing laws, showing additional legislation necessary, **74,** 203. Legislation required to prevent encroachments on river channel, and damage to piers, **74,** 202; **75,** 273; **76,** ii, 531; **77,** 933.

**Obstructions.**

Conditions imposed by Secretary of War for bridging the river, **79,** 1658.

**Operations.**

**1868–69.** 30 cribs, equal to 900 l. f. of pier, placed; repairs, **69,** 34, 35.

**1869–70.** Piers extended, 274 l. f., **70,** 45.

**1870–71.** Construction of superstructure; and outer crib of north pier repaired and replaced. Extension of south pier, 9 cribs 30 f. by 16 f. **71,** 175.

**1871–73.** Construction of superstructure on south pier, by purchase in open market and hired labor, **72,** 40; **73,** 40.

**1873–74.** Repairs, and dredging, **74,** 201, 205.

**1874–75.** Repairs, **75,** 272.

**1879–80.** Construction of revetment along northeast bank of river, **80,** 2038.

**1880–81.** Revetment from the Oscoda Bridge to U. S. piers completed, **81,** 2245. Construction by hired labor of training wall across bar at entrance to mouth of harbor, **81,** 2246.

**1881–82.** Extension of south pier by hired labor and dredging by contract of 3,000 c. y. of sand from bar at mouth of harbor, **82,** 2330.

**1882–83.** Slight repairs by hired labor, **83,** 1854.

**1889–90.** 12,864 c. y. dredged, **91,** 2724.

**Physical characteristics.** (See *Private work.*)

Description, **66,** iii, 8, iv, 76; sand brought down by current, **67,** 149; river long, rapid, and full of sand, deposit of sand at mouth, **69,** 107. The 10-f. curve advanced 280 f., **72,** 205; curve advanced 260 f., **73,** 291.

**Plans.** (See *Estimates* and *Projects.*)

By H. G. Rothwell, breakwater, ¾ mile from piers, **73,** 291.

**Private work.**

Private piers injured by freshet, **69,** 108. Character of work not substantial, **70,** 151. Damage to harbor from indiscreet dredging by private parties, **72,** 205. Encroachments on river channel, **73,** 291; **74,** 203. The necessary jurisdiction ceded to U. S. by owners of river fronts, **79,** 169, 1657.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Raynolds, 1866, for the extension of the piers to 12 f. curve and dredging for the formation of a channel to that depth; estimated cost, $114,754, **66,** iv, 77; **85,** 2132.

By Col. Cram, for modifications of Maj. Raynolds's plan, depth of channel 10 f., adopted; estimated cost, $82,893, **67,** 147, 149, 151; **69,** 107; **85,** 2133.

By Maj. Poe, for increase in width of cribs to 18 f., sheet-piling the north side of river for 1,000 f., **70,** 152, 153–158.

By Maj. Weitzel, for extension of north pier, and dredging bar at mouth of river as experiments, **72,** 206; **73,** 291.

After the expenditure of appropriations aggregating $95,970, Maj. Harwood, 1879, proposed, at an estimated cost of $35,000

## AUSABLE HARBOR AND RIVER, MICH.—Continued.

for the completion of the improvement, the formation of a channel 10 f. deep and 100 f. wide, extending from deep water in the lake to the State street bridge in Ausable (S. Ex. Doc. 79, 45th Cong., 3d sess.), **79**, 1657. Estimate, 1883, by Maj. Farquhar, $32,121, **83**, 1857.

In 1885 Lt. Col. Poe reported that the formation of the bar at entrance to the harbor precluded its improvement at a cost commensurate with the advantages to be gained, **85**, 2130; **86**, 322. Expenditures resulted in a depth of 4 f. on the bar and 8 f. in the channel from bar to Oscoda Bridge, **85**, 2137.

In 1891 Col. Poe reported against any further attempts to secure a permanent improvement, **91**, 2771.

**Surveys.**

Under directions of Maj. Raynolds, 1866, **66**, ii, 41, iii, 8. Report, **66**, iv, 76, 90.

Under direction of Col. Cram, resurvey, 1866, **67**, 147; **68**, 141.

Under direction of Maj. Poe, 1872, of a bar 1 mile from the ends of piers, **72**, 206.

Under direction of Maj. Weitzel, 1874, resurvey of river, and establishing dock lines, **75**, 272, 286.

By H. A. Ulffers, 1875, under direction of Maj. Weitzel, **76**, ii, 550.

Under direction of Maj. Harwood, 1882, **82**, 2330.

Under direction of Maj Farquhar, 1883, **83**, 1854.

Examination of Ausable River for a 12 f. channel and breakwater, ordered by act of August 11, 1888, made, 1888, under direction of Col. Poe (report unfavorable), **89**, 2279.

MAPS.

Of survey by H. G. Rothwell, under direction of Maj. Weitzel, 1874, S. Doc. 70, 45th Cong., 3d sess.

**82**, 2330; **83**, 1856.

## AUX BECS SCIES LAKE, MICH. (See *Frankfort Harbor, Mich.*)

## BABYLON CREEK, N. Y.

**Commerce.**

Estimated annual commerce of 3,000 t., which would probably be increased to 18,000 t. after improvement of the stream, **97**, 1173.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 140.

ENGINEER IN CHARGE. Maj. H. M. Adams, 1896–97. Report, **97**, 1172.

**Physical characteristics.**

Description of, **97**, 1173.

**Survey.**

Examination ordered by act of June 3, 1896, made by Maj. Adams, 1897 (report unfavorable), **97**, 1173.

## BACK BAY, BILOXI, MISS. (See *Biloxi Bay.*)

**Commerce.**

Description of. In 1893 the annual saving to commerce by the improvement proposed would not amount probably to $10,000. **93**, 1784.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 238.

ENGINEER IN CHARGE. Maj. A. N. Damrell, 1893. Report, **93**, 1784.

ASSISTANT. Lt. E. E. WINSLOW. Report, **93**, 1785.

**Physical characteristics.**

Description of; the Back Bay of Biloxi is about 10 miles long with an average width of about 1 mile, **93**, 1785.

**Surveys.**

Examination of Biloxi Bay north of the town of Biloxi up to the town of Handsboro with a view to removal of bars ordered by act of July 13, 1892, made under the direction of Maj. Damrell, 1892, (report unfavorable), **93**, 1784.

## BACK BAY, HANDSBOROUGH, MISS. (See *Handsborough, Miss.*)

## BACK COVE. (See *Sasanoa River, Me.*)

## BACK COVE, PORTLAND, ME. (See *Portland.*)

## BACK CREEK, Md.[a]

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[a] **Survey.** Report, Apr. 3, 1830, estimate, $40,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

**BACK RIVER.** (See *Harris Creek, Va.*)

**BACK RIVER, ME.** (See *Sasanoa River; Gut opposite Bath.*)

**BAD RIVER.** (See *Shiawassee River, Mich.*)

**BAGADUCE (BAYADUCE) RIVER, ME.** (See *Penobscot River, Me.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $3,000, | **89,** | 511. |
| 1890, | 4,000, | **90,** | 432. |
| 1892, | 5,000, | **92,** | 503. |
| 1894, | 5,000, | **95,** | 547. |
| 1896, | 5,000, | **96,** | 549. |
| 1899, | 3,000, | **99,** | 1031. |
| Total, | 25,000 | | |

**Contracts.**

**1893.** E. P. Lovering, dredging, 25 cents per c. y. ($12,500); removal of bowlders weighing not less than 250 lbs., $3 per t., **93,** 682.

**1895.** Columbian Dredging Co., removal of bowlders, $4 per t. ($8,000), **95,** 547.

**1897.** Robert H. Rogers, removal of bowlders, $9.87 per t., ($987), **98,** 821.

**1900.** Townsend & Olsen, removing rock and bowlders, $1.59 per t. of 2,000 lbs., **1900,** 1085.

**Engineers.**

Chief of Engineers. Reports, **88,** 13, 22; **89,** 21; **90,** 17; **91,** 22; **92,** 26; **93,** 24, 37; **94,** 24; **95,** 25; **96,** 28; **97,** 30; **98,** 40, 53; **99,** 48; **1900,** 51.

Engineers in Charge:

Lt. Col. J. A. Smith, 1888–92. Reports, **88,** 398; **89,** 511; **90,** 432; **91,** 578.

Lt. Col. P. C. Hains, 1892–94. Reports, **92,** 502; **93,** 681, 724; **94,** 498.

Lt. Col. D. P. Heap, 1895. Report, **95,** 546.

Lt. Col. A. N. Damrell, 1896. Report, **96,** 548.

Maj. R. L. Hoxie, 1897–98. Reports, **97,** 778; **98,** 821, 842.

Maj. S. W. Roessler, 1899—. Reports, **99,** 1031; **1900,** 1084.

Assistant. F. S. Burrowes. Report, **88,** 402.

**Operations.**

**1893–94.** About 30,000 c. y. dredged, and 506½ tons of bowlders removed, **94,** 498.

**1894–95.** 1,150 tons of bowlders removed, **95,** 547.

**1897–98.** About 450 tons of bowlders removed, **98,** 821.

**1899–1900.** 83 tons rock removed, **1900,** 1084.

**Physical characteristics.**

Character and dimensions of the natural channel from the mouth to Penobscot, **88,** 399.

Description of, **93,** 724.

**Projects.**

By Lt. Col. Smith, 1888, to straighten and deepen the channel by dredging and rock removal, giving a width of 150 f. from Bridges Point to Winslows Island, and thence a width of 100 f. to the village of South Penobscot, with a depth of 6 f. at l. w. throughout; estimated cost, $45,000, **88,** 399, 402; **92,** 502.

**Surveys.**

Ordered by act of Aug. 5, 1886, made, 1888, under direction of Lt. Col. Smith, **88,** 401.

Examination of the south fork of the river, ordered by act of July 13, 1892, made, 1892, by Lt. Col. Hains (report unfavorable), **93,** 724.

Survey up to Penobscot village, ordered by act of June 3, 1896, made, 1897, by Maj. Hoxie (report unfavorable), **98,** 842.

**BAKERS AND WILLAPA (SHOALWATER) BAYS, WASH., Canal between.** (See *Shoalwater Bay.*)

**Commerce.**

Necessities of commerce, **82,** 2727.

**Engineers.**

Chief of Engineers. Reports, **81,** 332; **82,** 324.

Engineer in Charge. Capt. C. F. Powell, 1882. Report, **82,** 2724.

Assistant. R. A. Habersham. Report, **82,** 2725.

**Physical characteristics.**

Description of, Bakers and Shoalwater bays, **82,** 2724.

**Plans.**

By Capt. Powell, 1881, for water communication via Johnsons and Holmans lakes and Tarlet Slough, the canal part to be 40 f. wide at bottom; estimated cost, $512,520, **82,** 2725, 2727.

**Surveys.**

Previous surveys, **82,** 2725.

Ordered by act of Mar. 3, 1881, made, 1881, under direction of Capt. Powell, **82,** 2724.

## BALDWIN RIVER, N. Y.

**Commerce.**
None, and none looked for, **85**, 789.

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 114.

ENGINEER IN CHARGE. Maj. G. L. Gillespie, 1885. Report, **85**, 781.

**Physical characteristics.**
Locality described, **85**, 781.

**Plans.**
In 1884 Maj. Gillespie reported that the desired improvement would cost $20,000, **85**, 789.

**Surveys.**
Examination ordered by act of July 5, 1884, made under direction of Maj. Gillespie (report unfavorable), **85**, 789.

## BALTIMORE HARBOR, MD.[a] (See *Patapsco River; Potomac River.*)

**Appropriations.**

| | | |
|---|---|---|
| 1836, | $20,000, | **66**, iii, 36. |
| 1837, | 15,000, | **66**, iii, 36. |
| 1838, | 20,000, | **66**, iii, 36. |
| 1852, | 20,000, | **66**, iii, 36. |
| 1856, | 100,000, | **66**, iii, 36. |
| 1864, | 20,000, | **66**, iii, 36, |
| 1866, | 5,200, | **66**, ii, 24, iii, 23; **67**, 426; **70**, 419. |
| 1867, | 75,000, | **67**, 420, 423, 426; **70**, 419. |
| 1868, | 17,000, | **68**, 25, 62, 691; **69**, 53; **70**, 419. |
| 1869, | 26,730, | **69**, 22. |
| 1870, | 42,900, | **70**, 69, 420; **71**, 71, 585. |
| 1871, | 50,000, | **71**, 71. |
| 1872, | 100,000, | **72**, 67, 680; **74**, ii, 18. |
| 1873, | 200,000, | **73**, 72, 761; **74**, ii, 18. |
| 1874, | 75,000, | **74**, 81, ii, 18. |
| 1875, | 75,000, | **75**, 87, ii, 67. |
| 1876, | 75,000, | **76**, 62, 285; **77**, 59, 275. |
| 1878, | 75,000, | **78**, 65, 449. |
| 1879, | 160,000, | **79**, 76, 494. |
| 1880, | 100,000, | **80**, 626. |
| 1881, | 150,000, | **81**, 863. |
| 1882, | 450,000, | **82**, 844. |
| 1884, | 250,000, | **84**, 895. |
| 1886, | 150,000, | **86**, 874. |
| 1888, | 300,000, | **88**, 756. |
| 1890, | 340,000, | **90**, 988. |
| 1891, | 151,200, | **91**, 1229. |
| 1892, | [b]28,000. | |
| | 208,000, | **92**, 1007. |
| 1894, | 50,000, | **95**, 1177. |
| | [b]10,000, | **95**, 1182. |
| 1896, | [c]455,000, | **96**, 1000, 1006. |
| 1899, | 200,000, | **99**, 1406. |
| 1900, | 324,648, | **1900**, 1688. |
| Total, | 4,340,678 | |

**Commerce.**
Commercial interests of Baltimore, **89**, 929, 934; **90**, 989.

The development of business in the vicinity of, and in Baltimore warranted, 1892–93, an improvement of the harbor, **93**, 1263.

**Contracts.**
**1871.** M. F. Brainard, dredging, 28 cents per c. y., **71**, 71, 588; **73**, 761. A. Dodge, dredging, **72**, 679; **73**, 761.

**1872.** G. H. Ferris, dredging, **74**, ii, 22.

**1873.** Curtis, Fobes & Co., dredging, **73**, 761; **74**, ii, 22.

**1874.** Curtis, Fobes & Co., dredging, 16 cents per c. y., **75**, 86.

**1876.** Curtis, Fobes & Co., dredging, $9\frac{3}{4}$ cents per c. y., **77**, 275. Morris & Cummings, dredging, $12\frac{1}{2}$ cents per c. y., **75**, 86.

**1877.** A. P. Brown, dredging, $9\frac{1}{4}$ cents per c. y., **77**, 275.

**1878.** American Dredging Co., dredging, $9\frac{5}{8}$ cents per c. y., **79**, 494.

**1880.** G. C. Fobes & Co., dredging, $18\frac{7}{10}$ cents per c. y., **80**, 626.

**1881.** American Dredging Co., dredging, $10\frac{3}{4}$ cents per c. y., **81**, 864.

**1882.** Morris & Cumings Dredging Co., 2,500,000 c. y., 16 cents per c. y.; Thomas Potter, 500,000 c. y., $13\frac{1}{2}$ cents per c. y., **83**, 671.

**1884.** American Dredging Co., removal of 1,500,000 c. y., 15 cents per c. y.; completed June 30, 1885, **85**, 918.

**1886.** American Dredging Co., dredging, 13 cents per c. y., **87**, 861.

**1888.** American Dredging Co., dredging, 11 cents per c. y., **89**, 928.

**1889.** American Dredging Co., dredging, $11\frac{1}{2}$ cents per c. y., **89**, 929.

**1890.** American Dredging Co., dredging, $10\frac{1}{2}$ cents per c. y., **91**, 1229.

**1892.** National Dredging Co., dredging, 12 cents per c. y. ($30,000), **93**, 1250.

**1894.** Baltimore Dredging Co., dredging, $8\frac{1}{4}$ cents per c. y. ($20,625), **95**, 1177.

**1896.** Virginia Dredging Co., dredging, $7\frac{99}{100}$ cents per c. y., s. m., ($399,500), **97**, 1301.

**1897.** R. M. Spedden & Co., steel-hull tugboat, $24,487, **97**, 1302.

**1899.** S. Hess, dredging, $8\frac{33}{100}$ cents per c. y. ($833,000), **99**, 1406.

**1900.** Baltimore Dredging Co., dredging, 11 cents per c. y. ($11,000), **1900**, 1692.

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[a] Survey.—Report, Feb. 24, 1828; estimate, $23,081.58. Estimate required annually for dredging.—(H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Curtis Bay. (H. Doc. No. 482, 55th Cong., 2d sess.)

[c] Southwest Baltimore (Spring Garden), $5,000.

## BALTIMORE HARBOR, MD.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 3, ii, 24, 41, iii, 23, 36; **67**, 41, 42, 424; **68**, 25, 62; **69**, 25, 62; **70**, 69; **71**, 71; **72**, 67; **73**, 72; **74**, 81; **75**, 86; **76**, 63; **77**, 58; **78**, 64; **79**, 76; **80**, 101; **81**, 134; **82**, 131; **83**, 135; **84**, 142; **85**, 137; **86**, 133; **87**, 97, 101; **88**, 95; **89**, 113; **90**, 102; **91**, 132; **92**, 132; **93**, 144, 145, 148; **94**, 132, 133; **95**, 152, 154, 157; **96**, 137, 138; **97**, 172, 173, 174; **98**, 175, 176, 177; **99**, 203, 204, 205; **1900**, 231, 233.

BOARD OF ENGINEERS. An advisory board appointed by the President at the request of the State of Maryland to consider the pier and bulkhead lines of Baltimore Harbor. Reports, **79**, 497, 500.

(Brig. Gen. Humphreys, C. P. Patterson, U. S. C. S., and Maj. Craighill.)

ENGINEERS IN CHARGE:

Maj. H. Brewerton, 1853, **66**, 37.

Col. J. D. Graham, 1865, **66**, 3. Report, **66**, 37, 38, 39, ii, 24.

Maj. J. G. Parke, in 1867, **68**, 694.

Col. J. H. Simpson, 1868–70. **68**, 694. Reports, **68**, 688; **69**, 374; **70**, 416, 420.

Maj. W. P. Craighill, 1866–94. **66**, ii, 24. Reports, **66**, iv, 232–236; **67**, 417, 423, 424; **71**, 585; **72**, 679; **73**, 760; **74**, ii, 17–23; **75**, ii, 66; **76**, 284; **77**, 273; **79**, 492; **80**, 625; (Lt. Col.) **81**, 860; **82**, 843; **83**, 669; **84**, 894; **85**, 917; **86**, 874; (Col.) **87**, 860, 880; **88**, 756; **90**, 987; **91**, 1227; **92**, 1005; **93**, 1243, 1249, 1262; **94**, 909, 914.

Capt. C. B. Phillips, 1878, in temporary charge. Report, **78**, 447.

Capt. T. Turtle, 1889–90. Report, **89**, 927.

Lt. Col. P. C. Hains, 1895–99. Reports, **95**, 1175, 1181, 1201; (Col.) **96**, 999, 1005; **97**, 1299, 1306, 1307, 1308; **99**, 1405, 1409, 1410.

2d Lt. C. W. Kutz, 1898. Report, **98**, 1175, 1180, 1181.

Lt. Col. O. H. Ernst, 1900. Report, **1900**, 1687, 1692, 1693.

ASSISTANTS:

Lt. W. R. Livermore, **69**, 52.

Capt. C. B. Phillips, **71**, 71; **72**, 67; **73**, 70; in immediate charge, **77**, 275.

N. H. Hutton, in immediate charge, **74**, ii, 23; **85**, 918.

**Estimates.** (See *Projects.*)

For Brewerton Channel, 150 f. wide, 22 f. deep, $390,000, **70**, 419.

By Lt. Col. Graham, 1865, for removal of lumps from channel by dredging, $5,200, **66**, 38.

By Maj. Craighill, 1866, for channel, 150 f. by 22 f., $193,050 to $223,500; for channel 200 f. by 22 f., $320,250 to $329,700, **66**, ii, 24, 25; revised after resurvey to $164,700 to $148,500; $295,200 to $198,900, **66**, iv, 233, 234. The latter adopted, **70**, 419.

For completing the work, $250,000, **67**, 417.

By Col. Simpson, 1869, for completing revised project, $107,600, **70**, 420.

By Maj. Craighill, 1871, numerous estimates for widening and deepening the channel, **71**, 585.

By Maj. Craighill, 1879, for completing existing project, $100,000, **79**, 494; $50,000 per annum for repairs, **79**, 492.

**Legislation.**

An act to protect the "Craighill Channel," **81**, 863. Protection of aids to navigation, **82**, 844.

**Operations.**

**1865–66.** Dredging with U. S. dredges, **66**, ii, 25.

**1866–67.** Dredging in Brewerton Channel below North Point, **67**, 42.

**1867–68.** Result of dredging, the extension of channel from Brewerton Channel south, past the Belvidere Shoal, with width of 500 f. for a distance of 5 miles, **68**, 62, 688.

**1868–69.** Dredging in Brewerton and Craighill channels, **69**, 52, 374.

**1869–70.** Dredging in Brewerton and Craighill channels, **70**, 416, 417.

**1870–71.** Dredging with U. S. dredges, and by contract, in Brewerton and Craighill channels, **71**, 71, 585, 586.

**1871–72.** Dredging by contract, **72**, 67, 679.

**1872–73.** Dredging by U. S., **73**, 72, 761, 762.

**1873–74.** Dredging continued, **74**, 81, ii, 17.

**1874–75.** Dredging by contract continued, **75**, 86.

**1875–76.** Brewerton Channel widened 40 f. by dredging, **76**, 63, 284.

**1876–77.** Dredging by contract continued, **77**, 58, 274.

**1877–78.** Dredging 300,145 c. y., **78**, 64, 449.

**1878–79.** Dredging 481,416 c. y., **79**, 76, 493.

**1879–80.** 431,000 c. y. dredged, **80**, 625.

**1880–81.** 181,930 c. y. dredged, **81**, 860.

**1881–82.** 709,725 c. y. dredged, **82**, 843.

**1882–83.** 2,554,861 c. y. dredged, **84**, 895.

**1883–84.** 1,583,397 c. y. dredged, **84**, 895.

**1884–85.** 1,715,247 c. y. dredged, **85**, 918.

**1886–87.** 1,111,317 c. y. dredged, **87**, 860.

**1888–89.** 200,000 c. y. dredged, **89**, 928.

**BALTIMORE, HARBOR, MD.**—Continued.

**1890–91.** 1,334,000 c. y. dredged, **91**, 1228.

**1891–92.** 3,506,443 c. y. dredged, **92**, 1006.

**1892–93.** 1,366,493 c. y. dredged, **93**, 1244. Channel to Curtis Bay in Patapsco River, Baltimore Harbor, dredged to a depth of 25 f., **93**, 1250.

**1894–96.** In connection with previous year 341,420 c. y. dredged, **95**, 1176; **96**, 1000.

**1896–97.** 1,270,582 c. y., s. m., dredged, **97**, 1300.

**1897–98.** 3,423,708 c. y., s. m., dredged, **98**, 1176.

**1899–1900.** 2,057,414 c. y. dredged, **1900**, 1688, 1692.

**Physical characteristics.**

**66**, 37, ii, 25; **67**, 420, 421; **74**, ii, 19, 22, 23; **79**, 493; **95**, 1201.

Description of southwest Baltimore Harbor, **96**, 1006.

**Private (City and State) work.**

Dredging by City and State authorities, **66**, ii, 25.

The City and State, from 1852 to 1868, appropriated for harbor improvement, $257,233.81; $184,317.06 expended in deepening channel below Fort McHenry, **70**, 419.

The City appropriated $200,000 for dredging, **72**, 67, 679; $200,000 more, **73**, 72, 761, 762.

History, **74**, ii, 19, 23.

The State of Maryland appropriated $5,000, in 1876, to defray the expenses of an advisory board and survey. Reports, **79**, 497–500.

The City of Baltimore and State of Maryland contributed up to 1885 $584,000 toward the improvement, **85**, 138.

$500,000 expended in work of improvement by the City of Baltimore and the State of Maryland, up to 1890, **91**, 133.

**Projects.** (See *Estimates.*)

From 1836 to 1838, inclusive, $55,000 was appropriated for Baltimore Harbor, **66**, iii, 36.

In 1852 the project originated for improving the channels at the approach from deep water in Chesapeake Bay, and was begun under the joint action of the Government and State of Maryland in the improvement of the Brewerton Channel to a width of 150 f. and a depth of 22 f., **67**, 420; **70**, 418; **74**, ii, 19; **79**, 492.

In 1866 Maj. Craighill proposed an alteration in the direction of a part of the channel, with a widening of the channels to 200 f., **66**, iv, 233, 234; **67**, 42, 417, 420, 422.

In 1872 the project was revised to provide for channels 24 f. deep at m. l. w. and from 250 to 400 f. wide, **72**, 67; **73**, 761; **74**, 221.

In 1881 Lt. Col. Craighill proposed the deepening of the channels to 27 f. at m. l. w., together with the formation of a cut-off between the lower part of the Brewerton and the upper part of the Craighill channels, **81**, 861. This work was practically accomplished in 1886, **86**, 874.

The total amount appropriated from 1852 to 1886, inclusive, was $2,216,830.

By Col. Craighill, 1887, for improvement of the channels between deep water in Chesapeake Bay and Baltimore, by dredging to 27 f. m. l. w., and 600 f. width; estimated cost, $1,300,000, **87**, 860, 881; **88**, 756.

Amount estimated for completion in 1891, $208,800, **91**, 134.

By Col. Craighill, 1890, for dredging a channel 150 f. wide at bottom and 27 f. deep at m. l. w., from the main ship channel of the Patapsco River, Baltimore Harbor, to Curtis Bay, estimated cost, $85,000, **93**, 1249.

By Col. Craighill, 1894, for dredging a channel 30 f. deep, 600 f. wide at bottom, and over 1,200 f. at the bends, in Baltimore Harbor, estimated cost, $2,500,000, and $50,000 annually for maintenance, **95**, 1202; **96**, 1000; **97**, 1300.

By Col. Hains, 1896, for dredging a channel 100 f. wide at bottom with side slopes of 1 on 3 from the main ship channel near Fort McHenry to the foot of Eutaw street, with a turning basin 400 f. by 400 f. near the upper end, estimated cost, $314,000, **96**, 1007.

**Surveys.**

Made, 1859, **66**, ii, 25.

By Col. Graham, 1865, examination, **66**, 37.

By Maj. Craighill, 1866, examination, **66**, ii, 24.

Under direction of Maj. Craighill, by United States Coast Survey, resurvey, 1866, **66**, iii, 23; iv, 234; **67**, 41, 42, 417.

Under direction of Maj. Craighill, resurvey, 1874, **74**, 81, ii, 17.

Under direction of Coast Survey, by I. M. Down, pier and bulkhead lines. Reports, **79**, 499,500.

By J. L. Seager, 1881, **81**, 862.

Survey of channels, 1885, **86**, 874.

Survey of channel with a view of widening it to 600 f., ordered by act of Aug. 5, 1886, made, 1886, under direction of Col. Craighill, **87**, 880.

Examination of the south and middle branches of the Patapsco River, ordered by act of July 13, 1892, made, 1892, by Col. Craighill (report favorable), **93**, 1262.

Surveys made by Col. Craighill and Col. Hains, **94**, 910; **96**, 1000.

Survey of Baltimore Harbor, ordered by

## BALTIMORE, HARBOR, MD.—Continued.

act of Aug. 17, 1894, made by Col. Craighill, 1894 (see *Projects*), **95**, 1201.

Estimated cost of deepening channel, southwest Baltimore Harbor, called for by resolution of Congress, Mar. 2, 1896, submitted, 1896, by Col. Hains, **96**, 1006.

Survey of Baltimore Harbor with a view to securing a 30-f. channel, ordered by act of June 3, 1896, made by Col. P. C. Hains, 1896 (see *Projects*), **97**, 1308.

MAPS. Of Patapsco River and approaches, **66**, 42; **95**, 1180; **97**, 1306.

## BANGOR HARBOR. (See *Penobscot River, Me.*)

## BANGOR TO WHITEHEAD. (See *Penobscot River, Me.*)

## BARATARIA BAY. (See *Little Lake, La.*)

## BARATARIA BAY, LA., NEW ORLEANS TO GRAND PASS.

**Commerce.**

Description, **81**, 1313.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 197.

ENGINEER IN CHARGE. Maj. C. W. Howell, 1880–81. Report, **81**, 1307.

**Plans.**

By Maj. Howell, 1881, for 5-f. navigation from New Orleans to Barataria Bay, by removal of obstructions and dredging, estimated cost for route No. 1, $78,486.87, No. 2, $108,158.32, **81**, 1314.

**Private (corporate) work.**

Three private canals on routes used by commerce, **81**, 1308, 1313; rate of tolls charged, **81**, 1314.

**Surveys.**

Under direction of Capt. G. W. Hughes, **81**, 1307.

By H. S. Douglass, 1880, from New Orleans to Grand Pass, **81**, 1307, 1308.

## BARCELONA HARBOR, N. Y. (See *Portland Harbor.*)

## BAR HARBOR, ME., breakwater.

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $50,000, | **88**, 13. |
| 1890, | 50,000, | **90**, 431. |
| 1892, | 50,000, | **92**,501. |
| 1893, | 10,000, | **95**, 545. |
| 1894, | 10,000, | **96**, 546. |
| 1894 | 6,391.12, | act June 23. |
| 1899, | 20,000, | **99**, 1022. |
| Total, | 196,391.12. | |

**Contracts.**

**1889.** F. S. Andrews, furnishing and placing stone on breakwater, $1.10 per t., **89**, 511.

**1890.** T. R. Smith, furnishing and placing stone on breakwater, $1.23½ per t., **91**, 578. Contract annulled, **92**, 501.

**1892.** W. S. White, riprap breakwater construction, $1.02 per t., **92**, 501. G. M. Neelon, riprap breakwater construction, $1.23½ per t., **92**, 501.

**1893.** Wm. S. White, stone, 97 cents per t. ($48,500), **94**, 497.

**1895.** Hamilton & Cleaves, stone, 74 cents per t. ($7,400), **95**, 546.

**1896.** Hamilton & Cleaves; stone, 84½ cents per t. ($8,450), **97**, 775.

**1900.** W. S. White, stone, 78 cents per t., **1900**, 1080.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 22; **88**, 13; **89**, 21; **90**, 16; **91**, 21; **92**, 25; **93**, 23; **94**, 23; **95**, 25; **96**, 26; **97**, 28; **98**, 38; **99**, 46; **1900**, 47.

ENGINEERS IN CHARGE:

Maj. J. A. Smith, 1887–92. Reports, **87**, 481; (Lt. Col.) **89**, 509; **90**, 430; **91**, 576.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 500; **93**, 676; **94**, 496.

Lt. Col. D. P. Heap, 1895. Report, **95**, 544.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 545.

Maj. R. L. Hoxie, 1897–98. Reports, **97**, 775; **98**, 817.

Maj. S. W. Roessler, 1899–. Reports, **99**, 1022; **1900**, 1079.

**Operations.**

**1889–90.** 11,393 t. stone delivered in breakwater, **90**, 431.

**1890–91.** 6,127 t. stone delivered in breakwater, **91**, 577.

**1891–92.** Construction of breakwater continued, **92**, 501.

**1892–93.** About 22,000 t. stone posited, **93**, 677.

## BAR HARBOR, ME., breakwater—Continued.

**1893–94.** About 64,000 t. stone deposited, **94,** 496.

**1894–95.** About 22,000 t. stone deposited, **95,** 545.

**1895–96.** About 15,000 t. stone deposited, **96,** 546.

**1896–97.** About 11,000 t. stone deposited, **98,** 817.

**1899–1900.** 13,898 t. stone deposited, **1900,** 1079.

**Physical characteristics.**

Description, **87,** 481.

**Projects.**

By Lt. Col. Smith, for construction of riprap breakwater, with concrete superstructure, extending from Round Porcupine Island to Porcupine Dry Island, and thence to within 400 f. of the shore line, a total distance of 3,425 f.; estimated cost, $500,000, **87,** 484. Revised, 1889, to $800,000, **89,** 510. Increased, 1891, to $806,000, **91,** 577.

Project amended, 1893, to provide for the construction of the breakwater for a distance of only 600 f. from Mount Desert Island, with slopes of 1 on 1, 20 f. wide on top, reducing the estimated cost of the work to about $420,200, **96,** 677.

**Surveys.**

Examination and survey ordered by act of Aug. 5, 1886, made, 1887, under direction of Maj. Smith, **87,** 483.

MAPS. **87,** 483; **91,** 576.

## BAR LAKE, MICH. (See *Empire Lake.*)

## BARNEGAT AND GREAT EGG HARBOR BAYS, N. J., *Sound between.*

**Engineers.**

CHIEF OF ENGINEERS. Report, **91,** 118.

ENGINEER IN CHARGE. Maj. C. W. Raymond. Report, **91,** 1094.

**Physical characteristics.**

Description of, **91,** 1094.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Raymond (report unfavorable), **91,** 1094.

## BARNEGAT BAY, N. J.

**Commerce.**

Description of, **97,** 1230.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97,** 154.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1897. Report, **97,** 1229.

ASSISTANT. Lt. S. Cosby. Report, **97,** 1229.

**Physical characteristics.**

Description of the bay and the locality, **97,** 1229.

**Surveys.**

Examination made by Lt. Col. C. S. Stewart, in 1868, to determine the necessity of opening an inlet from the Atlantic Ocean at a point near the head of Barnegat Bay. Reports, **68,** 64, 708, 710.

Examination ordered by act of June 3, 1896, made by Maj. Raymond, 1896 (report unfavorable), **97,** 1229.

## BARNEGAT INLET, N. J. (See *Cranberry Inlet, N. J.*)

**Commerce.**

Commerce local and unimportant, **93,** 1186.

**Engineers.**

CHIEF OF ENGINEER. Report, **93,** 129.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1892–93. Report, **93,** 1185.

**Physical characteristics.**

Description of, **93,** 1186.

**Surveys.**

Examination ordered by act of July 13, 1892, made by Maj. Raymond, 1892 (report unfavorable), **93,** 1185.

## BARNSTABLE BAY. (See *Buzzards Bay* and *East Dennis, Mass.*)

## BARREN RIVER, KY. (See *Green and Barren rivers.*)

## BARTHOLOMEW BAYOU, ARK. AND LA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1881, | $8,000, | **81**, | 1422. |
| 1882, | 5,000, | **82**, | 1559. |
| 1884, | 5,000, | **84**, | 1331. |
| 1886, | 5,000, | **86**, | 1353. |
| 1888, | 5,000, | **88**, | 1352. |
| 1890, | 5,000, | **90**, | 1884. |
| 1892, | 5,000, | **92**, | 1613. |
| 1894, | 5,000, | **95**, | 1919. |
| 1896, | 4,000, | **96**, | 1604. |
| 1899, | 5,000, | **99**, | 2001. |

Total, 52,000.

**Commerce.**

Importance of improvement to, **72**, 383.

Reduction of insurance due to improvement, **83**, 1159.

Cotton trade of the bayou, and reduction in freight rates thereon, **90**, 1884; **91**, 1983.

**Contracts.**

**1884.** Emmick & Feith, removal of obstructions, $75 per mile, **85**, 1501.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 59; **72**, 55; **78**, 88; **79**, 118; **80**, 158; **81**, 211, 213; **82**, 208; **83**, 217; **84**, 222; **85**, 235; **86**, 231; **87**, 196; **88**, 179; **89**, 210; **90**, 189; **91**, 240; **92**, 232; **93**, 262; **94**, 242; **95**, 271; **96**, 236; **97**, 303; **98**, 294; **99**, 352; **1900**, 404.

ENGINEERS IN CHARGE:

Lt. Col. W. F. Raynolds, 1872. Report, **72**, 390.

Maj. W. H. H. Benyaurd, 1879–82. Reports, **79**, 997; **81**, 1422, 1453; **82**, 1558.

Maj. A. M. Miller, 1882–84. Reports, **83**, 1158; **84**, 1330.

Capt. E. Bergland, 1884–86. Reports, **85**, 1501, 1548; **86**, 1353.

Capt. J. H. Willard, 1886–99. Reports, **87**, 1459; **88**, 1351; **89**, 1601; **90**, 1882; **91**, 1982; **92**, 1610, **93**, 2012; **94**, 1471; **95**, 1917; (Maj.), **96**, 1601; **97**, 1914; **98**, 1613; **99**, 2000.

Maj. T. L. Casey, 1900——. Report, **1900**, 2513.

ASSISTANTS:

A. H. Blaisdell. Report, **73**, 383.
M. L. Lum. Report, **79**, 997.
R. M. Spicer. Report, **83**, 1159.
C. Quinn. Report, **85**, 1549.

**Legal proceedings.**

Appropriation by State for improvement declared unconstitutional, **72**, 385; **79**, 1002.

**Operations.**

**1881–82.** Removal by hired labor of 9,954 trees and logs, 5 drift piles, and 1 wreck, **82**, 1558.

**1882–83.** Removal by hired labor of 4,341 trees, logs, and stumps, **83**, 1159.

**1884–85.** Removal by contract of 5,837 stumps, logs, and snags, 2 wrecks, 123 brush piles, and 697 leaning trees; clearing 66⅞ miles of the bayou, **85**, 1502.

**1886–87.** 5,289 trees, logs, and snags removed, **87**, 1460.

**1887–88.** 3,460 logs and snags removed from the channel, 3,126 trees, and 8,653 s. y. brush cut from the banks, **88**, 1351.

**1889–90.** 10,500 snags and 3 wrecks removed from the channel; 49,650 trees, 6,500 shore snags, and 9,325 s. y. brush cut from the banks, **90**, 1883.

**1890–91.** 1,670 snags removed from the channel, 10,852 stumps and logs removed from the channel and banks, and 44,600 trees girdled and removed, **91**, 1984.

**1891–92.** 3,470 snags and stumps removed; 10,105 shore snags and logs and 41,054 trees cleared from the banks, **92**, 1612.

**1893–94.** About 10,000 obstructions removed; over 8,000 s. y. brush and willows cut; and several wrecks removed, **94**, 1474.

**1894–95.** About 1,500 obstructions removed, **95**, 1919.

**1895–96.** About 12,700 snags and other obstructions, and 18,809 s. y. brush and willows removed, **97**, 1915.

**1897–98.** Over 1,500 snags and other obstructions, 1,094 s. y. brush and willows, and 450 cords drift removed, **98**, 1613.

**1898–99.** Boat repaired and a few obstructions removed from channel, **99**, 2000.

**1899–1900.** About 13,700 snags and other obstructions removed from channel and 56,000 s. y. willows and brush cut from banks, **1900**, 2514.

**Physical characteristics.**

Described, **72**, 384; **79**, 998, 999; **94**, 1473; **95**, 1919; **96**, 1603; **97**, 1914.

Considerable improvement in depths of bars below Lind Grove, La., noted, **94**, 1474.

Drift, caving, and sliding banks, and rapid growth of vegetation constantly adding new obstructions, becoming greater in quantity and more difficult to move each year, **98**, 1613.

**Plans.**

By A. H. Blaisdell, for removal of obstructions, $34,716, **72**, 383, 385, 386.

By M. L. Lum, for removal of obstructions, $23,005, **79**, 1003.

Capt. Bergland, 1885, estimated $20,000 as cost of removal of obstructions for navigation seven months in the year, **85**, 1549.

## BARTHOLOMEW BAYOU, ARK. AND LA.—Continued.

**Private (State) work.** (See *Legal proceedings.*)

Improvement of river by State of Louisiana in cutting trees and removing snags, **72**, 385; **79**, 1002.

Early improvement by State, **79**, 1000.

**Projects.**

By Maj. Benyaurd, 1880, for the improvement of the bayou from Baxter Station to its mouth, 213 miles, by the removal of trees, logs, and snags; estimated cost, $26,862, **81**, 1455.

No permanent improvement feasible, **85**, 235.

In 1897 Maj. Willard estimated it would cost $2,500 per year to maintain unobstructed navigation at stages when steamboats could run, **97**, 1917.

**Surveys.**

Ordered by act approved Mar. 3, 1871, **71**, 59; made under direction of Lt. Col. Raynolds, by A. H. Blaisdell, C. E. Report, **72**, 383.

Ordered by act approved June 18, 1878, **79**, 118; made under direction of Maj. Benyaurd, by M. L. Lum. Report, **79**, 997.

Preceding examinations and surveys, **81**, 1454.

Examination made in 1884, **85**, 1501.

Examination from head of navigation to Lincoln County line ordered by act of July 5, 1884, made, 1885, under direction of Capt. Bergland (report unfavorable), **85**, 1549.

Survey of the bayou in connection with Ouachita River, **96**, 1604.

## BASS ISLAND. (See *Starve Island Reef, Ohio.*)

## BASS RIVER, MASS. (Bass River Harbor.)[a]

**Appropriations.**

| | |
|---|---|
| Mar. 2, 1829, | [b] $150.00 (survey). |
| July 4, 1836, | [b] 10,000.41 |
| July 7, 1838, | [b] 10,000.00 |
| Total, | 20,150.41 |

**Commerce.**

Description of. Purely local, with no prospect of increase. **95**, 739, **1900**, 1283.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 72; **99**, 97; **1900**, 110.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1895. Report, **95**, 739.

Maj. D. W. Lockwood, 1900. Report, **1900**, 1282.

**Physical characteristics.**

Probable effect on the proposed improvement by the construction of the Cape Cod Ship Canal in the vicinity, **95**, 739, 743.

Description of, **95**, 739, 743; **1900**, 1283.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made, 1895, by Capt. Bixby (report unfavorable), **95**, 739.

Examination ordered by act of Mar. 3, 1899, made, 1899, by Maj. Lockwood (report unfavorable), **1900**, 1283.

## BASTROP BAYOU, TEX.

**Commerce.**

None, and none looked for, **1900**, 2418.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900**, 395.

ENGINEER IN CHARGE. Capt. C. S. Riché, **1899–1900**. Reports, **1900**, 2414, 2416.

ASSISTANT. S. M. Wilcox. Report, **1900**, 2417.

**Physical characteristics.**

Bastrop Bayou empties into Bastrop Bay, part of West Galveston Bay, and is one of the adjacent streams referred to in the appropriation of Mar. 3, 1899, for improving "Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams", **1900**, 2415.

Description of, **1900**, 2417.

**Surveys.**

Examination and survey ordered by act of Mar. 3, 1899; examination made, 1899, by Capt. Riché (report favorable); survey made, 1899, under direction of Capt. Riché (report unfavorable), **1900**, 2415, 2416.

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[a] Survey.—Report, Feb., 1830, estimate, $19,930.41. H. Doc. No. 482, 55th Cong., 2d sess.

[b] Treas. Dept. Doc. No. 373, 1882.

**BATH, ME.** (See *Kennebec* and *Sasanoa rivers, Me.*)

**BATH CREEK, N. C.** (See *Town Creek, Brunswick County.*)

**BATON ROUGE HARBOR, LA.** (See *Mississippi River.*)

**Engineers.**

Chief of Engineers. Report, **89**, 202.

Engineer in Charge. Capt. W. L. Fisk, 1889. Report, **89**, 1511.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Fisk (report unfavorable), **89**, 1511.

**BATTERY DIAMOND REEF.** (See *East River, N. Y.*)

**BATTERY-GOVERNORS ISLAND, CHANNEL.** (See *New York Harbor, N. Y.*)

**BATTERY ISLAND, CHESAPEAKE BAY, MD.**

**Appropriation.**

1886, $17,275, **87**, 866.

**Engineers.**

Chief of Engineers. Report, **87**, 99.

Engineer in Charge. Col. W. P. Craighill, 1887. Report, **87**, 864.

**Operations.**

**1886–87.** 620 l. f. of crib-work sunk by hired labor to repair damaged part of breakwater, **87**, 865.

**Project.**

By Maj. W. F. Smith, U. S. agent, 1886, to repair piers and breakwater, and to riprap jetty; estimated cost, $17,275, **87**, 864.

**BATTERY REEF.** (See *East River, N. Y.*)

**BAYADUCE RIVER, ME.** (See *Bagaduce River.*)

**BAYFIELD HARBOR, WIS.**

**Engineers.**

Chief of Engineers. Report, **80**, 206.

Engineer in Charge. Maj. H. M. Robert, 1880. Report, **80**, 1929.

Assistant. L. Y. Schermerhorn. Report, **80**, 1929.

**Surveys.**

Ordered by act of Mar. 3, 1879, examination made under direction of Maj. Robert, nothing found, **79**, 155; **80**, 1929.

**BAYOUS.**

Alaqua. (See *Alaqua Bayou.*)
André. (See *André Bayou, La.*)
Bartholomew. (See *Bartholomew Bayou, Ark. and La.*)
Black. (See *Black Bayou, La.*)
Boeuf. (See *Boeuf Bayou, La.*)
Bonfuca. (See *Bonfuca Bayou.*)
Buffalo, Tex. (See *Buffalo Bayou.*)
Carlin. (See *Carlin Bayou, La.*)
Cassidy. (See *Cassidy Bayou.*)
Castain. (See *Castain Bayou.*)
Castor. (See *Castor Bayou, La.*)
Cedar. (See *Cedar Bayou, Tex.*)
Chevreuil. (See *Chevreuil Bayou, La.*)
Chitta. (See *Chitta Bayou, La.*)
Cocodrie. (See *Cocodrie Bayou, La.*)
Corney. (See *D'Arbonne Bayou, La.*)
Courtableau. (See *Courtableau, La.*)
Cypress. (See *Cypress Bayou.*)
D'Arbonne. (See *D'Arbonne Bayou, La.*)
Des Glaises. (See *Des Glaises Bayou.*)
Dorcheat. (See *Dorcheat Bayou, La.*)
Double. (See *Double Bayou, Tex.*)
Dugdemona. (See *Dugdemona River, La.*)
East Bay. (See *East Bay Bayou, Tex.*)
Fusilier. (See *Fusilier Bayou.*)

**BAYOUS**—Continued.

Grand Caillou. (See *Grand Caillou Bayou, La.*)
Grossetete. (See *Grossetete Bayou, La.*)
Johnson. (See *Johnson Bayou, La.*)
Kelley. (See *Kelley Bayou.*)
Lafourche. (See *Lafourche Bayou, La.*)
Lagrange. (See *Lagrange Bayou, Fla.*)
Little Caillou. (See *Little Caillou Bayou, La.*)
Loggy. (See *Loggy Bayou, La.*)
Macon. (See *Macon Bayou, La.*)
Manchac, La. (See *Amite River, Manchac Bayou.*)
Meto. (See *Metre Bayou.*)
Nezpique. (See *Mermentau River.*)
Old Fort. (See *Old Fort Bayou.*)
Petit Anse. (See *Petit Anse Bayou, La.*)
Pierre. (See *Cane River, La.; Lake Bayou Pierre, La.; Pierre Bayou, La.; Pierre Bayou, Miss.*)
Pierre Lake, La. (See *Tones Bayou.*)
Pigeon. (See *Plaquemine Bayou.*)
Plaquemine. (See *Plaquemine Bayou, La.*)
Red. (See *Red Bayou.*)
Rouge. (See *Rouge Bayou.*)
Roundaway. (See *Roundaway Bayou, La.*)
St. John. (See *St. John Bayou, La.*)
Steele. (See *Steele Bayou, Miss.*)
Teche. (See *Teche Bayou.*)
Tensas. (See *Tensas River, La.*)
Terrebonne. (See *Black Bayou; Terrebonne Bayou.*)
Tigre. (See *Chevreuil, La.*)
Tones. (See *Tones Bayou.*)
Vermilion. (See *Vermilion Bayou, La.*)
Vidal. (See *Vidal and Roundaway bayous.*)
Washington. (See *Washington Bayou, Miss.*)
Winsey. (See *Red River.*)

**BAY RIDGE CHANNELS, N. Y.** (See *Buttermilk Channel, Gowanus Bay, and Gowanus Creek Channel.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1896,[a] | $200,000, | **96**, | 757. |
| 1897,[a] | 350,000, | **97**, | 1120. |
| 1898,[a] | 130,000, | **98**, | 1018. |
| 1899,[b] | 100,000, | **99**, | 1270. |
| 1900,[b] | 262,000, | **1900**, | 1467. |

Total, 1,042,000

**Commerce.**

Description of, **97**, 1179.

Large and important, and would probably be still further enlarged by construction of deeper channels, **97**, 1179.

**Contracts.**

**1896.** W. H. Beard Dredging Co., dredging, 14 and 21 cents per c. y., s. m. ($630,000), **97**, 1121.

**1899.** Hughes Bros. & Bangs, dredging Bay Ridge and Red Hook channels, 10 cents per c. y., s. m. ($2,040,540), **1900**, 1468.

**Engineers.**

Chief of Engineers. Reports, **91**, 94; **96**, 95; **97**, 125, 140; **98**, 121; **99**, 144; **1900**, 163.

Engineers in Charge:

Lt. Col. G. L. Gillespie, 1890–91. Report, **91**, 940.

Maj. H. M. Adams, 1896–99. Reports, **96**, 753; **97**, 1117, 1177; **98**, 1016; **99**, 1266.

Maj. W. L. Marshall, 1900. Report, **1900**, 1464.

**Operations.**

**1895–96.** 718,487 c. y. dredged, **96**, 755.

**1896–97.** 872,617 c. y. dredged, **97**, 1119.

**1897–98.** 1,499,462 c. y. dredged, **98**, 1018.

**1898–99.** 1,844,410 c. y. dredged, **99**, 1268.

**Physical characteristics.**

Description of, **97**, 1179.

The channels included in this work form an eastern water route between the Narrows and East River, New York Harbor, running close to the water front of Brooklyn and Governors Island, **97**, 1178.

**Projects.**

By act of 1896, Bay Ridge and Red Hook channels, the triangular area be-

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[a] Bay Ridge, triangular area, Red Hook and Buttermilk channels.
[b] Bay Ridge and Red Hook channels.

## BAY RIDGE CHANNELS, N. Y.—Continued.

tween them, and Buttermilk Channel were consolidated into one work, including limited improvement of Gowanus Canal, **96**, 755.

By Maj. Adams, under act of 1896, for dredging channels, with width of 800 f. in Bay Ridge Channel, 900 f. in the triangular area, 400 f. in Red Hook Channel, 1,000 f. in Buttermilk Channel, and all with a depth of 26 f.; dredging was also provided for in Gowanus Canal to the extent of $5,000; total estimated cost, $837,000, **96**, 755.

In 1897 Maj. Adams estimated it would cost $2,000,000 to obtain 30-f. channels, and $5,300,000 to obtain 35-f. channels, both amounts in addition to the estimated cost of the project of 1896, **97**, 1179.

By Maj. Adams, 1899, for making Bay Ridge and Red Hook channels 1,200 f. wide and 40 f. deep, m. l. w., at a limit of cost of $2,500,000, and continuing contract for whole work authorized, **99**, 1267.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Gillespie (report unfavorable), **91**, 940.

Survey with a view to obtaining one continuous channel 30 f. deep, m. l. w., with a width of 1,000 f., and depth of 35 f., m. l. w., with width of 1,200 f., ordered by act of June 3, 1896, made, 1897, by Maj. Adams (see *Projects*), **97**, 1177.

MAPS. **96**, 756.

## BAY RIVER, ARK.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 158; **81**, 213.

ENGINEER IN CHARGE. Maj. W. H. H. Benyaurd, 1880. Report, **81**, 1497.

ASSISTANT. J. B. Rohrer. Report, **81**, 1497.

**Surveys.**

Ordered by act of June 18, 1878, **80**, 158, made under direction of Maj. Benyaurd, 1880 (report unfavorable), **81**, 1497.

## BAY RIVER, N. C. (See *Pamlico River*.)

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 177.

ENGINEER IN CHARGE. Capt. J. Mercur, 1884. Report, **84**, 1064.

**Physical characteristics.**

River, 1883, afforded easy navigation to all existing commerce, **84**, 1064.

**Surveys.**

Examination ordered by act of August 2, 1882, made under direction of Capt. Mercur (report unfavorable), **84**, 1064.

## BAY SHORE, LONG ISLAND, N. Y.

**Commerce.**

Description of, **1900**, 1442.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99**, 142; **1900**, 160.

ENGINEER IN CHARGE. Lt. Col. W. H. H. Benyaurd, 1900. Report, **1900**, 1441.

**Physical characteristics.**

Description of, **1900**, 1441.

**Surveys.**

Examination ordered by act of Mar. 3, 1899, made, 1899, by Lt. Col. Benyaurd (report unfavorable), **1900**, 1442.

## BEACH THOROUGHFARE, N. J.

**Commerce.**

A large traffic would be benefited by an improvement of the thoroughfare, **97**, 1237.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 154; **1900**, 208.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1896–97. Report, **97**, 1235.

ASSISTANT. Lt. S. Cosby. Report, **97**, 1236.

**Physical characteristics.**

Description of, **97**, 1236.

**Surveys.**

Examination ordered by act of June 3, 1896, made under direction of Maj. Raymond, 1896 (report favorable), **97**, 1235.

## BEAR CREEK (branch of the Tennessee River), MISS. (See *Tombigbee River, Miss.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 258; **88**, 213.

ENGINEERS IN CHARGE:

Maj. W. R. King, 1882. Report, **82**, 1869.

Lt. Col. J. W. Barlow, 1888. Report, **88**, 1639.

ASSISTANTS:

J. H. Mayhew. Report, **82**, 1870.

Lt. H. E. Waterman. Report, **88**, 1640.

**Physical characteristics.**

Description of, **82**, 1870; **88**, 1639.

**Plans.**

By Maj. King, 1881, for improving 12 miles of the creek by removing snags and fish traps. Estimated cost, $5,900, **82**, 1869, 1871.

By Lt. Col. Barlow, 1887. (1) For improving creek, Southard's Ford to mouth, 30 miles, with works of contraction and by removing snags and overhanging trees; estimated cost, $50,000. (2) For 3-foot slack-water navigation at all stages, with eight locks and dams; estimated cost, $500,000, **88**, 1641.

**Surveys.**

Examination ordered by act of Mar. 3, 1881, made, 1881, under the direction of Maj. King, **82**, 1869.

Ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. Barlow, **88**, 1639.

## BEAR CREEK (branch of the Yazoo River), MISS. (See *Tombigbee River, Miss.*)

**Commerce.**

Description of; unimportant, **95**, 1991.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 213; **82**, 210; **95**, 280.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1882. Report, **82**, 1563.

Capt. J. H. Willard, 1895. Report, **95**, 1990.

ASSISTANT: W. S. Davis. Report, **82**, 1563.

**Physical characteristics.**

Description of, **82**, 1563; **95**, 1990.

The creek a succession of small lakes and creeks about 80 miles long; runs dry during low water, the lakes becoming stagnant pools, **95**, 1990.

**Plans.**

By Maj. Benyaurd, 1881, for clearing out obstructions from about 44 miles of the creek and connecting lakes at an estimated cost of $6,000, **82**, 1563, 1565.

**Surveys.**

Examination ordered by act of Mar. 3, 1881; made, 1881, under the direction of Maj. Benyaurd, (see *Plans*) **82**, 1563.

Examination ordered by act of Aug. 17, 1894; made, 1895, by Capt. Willard (report unfavorable), **95**, 1990.

## BEAR CREEK HARBOR, LAKE ONTARIO, N. Y.

**Commerce.**

Entirely local, **73**, 385–387.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **72**, 48; **73**, 49.

ENGINEER IN CHARGE. Maj. J. M. Wilson, 1872–73, **72**, 48. Report, **73**, 385.

ASSISTANT. J. S. Lawrence. Report, **73**, 386.

**Estimates.**

By Maj. Wilson, pier extension and rock excavation, $250,181.93, **73**, 386, 388.

**Physical characteristics.**

General, of Bear Creek, **73**, 385, 386.

**Private (corporate) work.**

Improvement by a harbor company, **73**, 386, 387. Two piers, 60 f. apart, constructed, **73**, 386.

**Plans.**

By Maj. Wilson, for extending west pier to 12 f. of water; removing east pier and constructing new one parallel to, and 200 f. from west pier; also, excavating rock between the piers and in the creek to 12 f. of water; estimated cost, $250,181.73, **73**, 385–388.

**Surveys.**

Under the direction of Maj. Wilson by J. S. Lawrence, 1872. Report, **73**, 386.

## BEAR RIVER. (See *Sacramento and Feather rivers.*)

## BEATTYVILLE, KY. (lock and dam at). (See *Kentucky River.*)

**BEAUFORT.** (See *Bogue Sound, N. C.*; *Neuse River, N. C.*; *Savannah, Ga.*; and *White Oak River, N. C.*)

## BEAUFORT, N. C. (breakwater at).

**Commerce.**

In 1893 the anchorage appeared to be sufficient for the small commerce of Beaufort with its 200 inhabitants, **93**, 1460.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 183.

ENGINEER IN CHARGE. Maj. W. S. Stanton, 1892–93. Report, **93**, 1457.

**Physical characteristics.**

Description of, **93**, 1457.

The breakwater desired by the inhabitants of Beaufort to protect the town against the sea, and to arrest the destruction of the channel along its front, **93**, 1458.

**Surveys.**

Examination for a breakwater to protect the town of Beaufort, N. C., ordered by act of July 13, 1892, made by Maj. Stanton, 1893 (report unfavorable) **93**, 1457.

**BEAUFORT, N. C., NEW BERNE TO.** (See *New Berne, N. C., Beaufort to—inland line of navigation.*)

## BEAUFORT HARBOR, N. C.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1836, | [a] $5,000 | | |
| 1881, | 30,000, | **81**, | 1013. |
| 1882, | [b] 25,000, | **82**, | 1093. |
| 1884, | 20,000, | **84**, | 1039. |
| 1886, | 15,000, | **86**, | 989. |
| 1888, | 35,000, | **88**, | 878. |
| 1890, | 15,000, | **90**, | 1134. |
| 1892, | 10,000, | **92**, | 1139. |
| 1896, | 5,000, | **96**, | 1116. |
| Total, | 160,000 | | |

**Commerce.**

Draft of vessels seeking entrance, **81**, 1015.

Importance of the harbor, **81**, 1014; **82**, 1096; **85**, 1079; **87**, 1036.

Description of, **1900**, 1808.

**Contracts.**

**1888.** P. Linehau & Co., stone, $2.95 per t., **87**, 1034.

**1889.** C. T. Caler, dredging, 37½ cents per c. y. F. H. Smith, furnishing stone, $2.19 per t. **89**, 1070.

**1890.** Alabama Dredging and Jetty Co., dredging, 33½ cents per c. y., **91**, 1370.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 164; **82**, 159, 1095; **83**, 166; **84**, 169; **85**, 168, 1082; **86**, 164; **87**, 128; **88**, 121; **89**, 140; **90**, 126; **91**, 161; **92**, 161; **93**, 174; **94**, 160; **95**, 183; **96**, 165; **97**, 204; **98**, 206; **99**, 238; **1900**, 271.

BOARD OF ENGINEERS:

For river and harbor improvements. Report, **82**, 1096. (See *Projects.*) (Cols. Tower, Newton, and Lt. Col. Abbot.)

ENGINEERS IN CHARGE:

Capt. C. B. Phillips, 1880–81. Report, **81**, 1013.

Capt. J. Mercur, 1881–84. Reports, **82**, 1093, 1094; **83**, 885.

Capt. F. A. Hinman, 1884–85. Report, **84**, 1039.

Capt. W. H. Bixby, 1885–91. Reports, **85**, 1076, 1080; **86**, 986; **87**, 1030; **88**, 875; **89**, 1066; **90**, 1131; **91**, 1367.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1137; **93**, 1395; **94**, 1031; **95**, 1323.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1115.

Capt. W. E. Craighill, 1897–98. Reports, **97**, 1396; **98**, 1247.

Capt. E. W. Van C. Lucas, 1899. Reports, **99**, 1498; **1900**, 1808.

ASSISTANTS:

C. M. Yeates. Report, **81**, 1014.

R. Ransom. Reports, **82**, 1094; **83**, 856; **84**, 1040; **85**, 1077; **86**, 985; **87**, 1034; **88**, 878.

H. F. Price. Report, **85**, 1078.

E. D. Thompson. Reports, **87**, 1035; **88**, 878, 879; **89**, 1070; **90**, 1134.

W. H. Chadbourne. Reports, **91**, 1370; **92**, 1139.

**Operations.**

**1881–82.** Two scows built by hired labor; 30 l. f. of jetty built, **82**, 1093, 1094; **86**, 989.

**1882–83.** Jetty at Shackleford Point extended to length of 535 f. Two scows and temporary wharf and tram-way built. Work done by hired labor, **83**, 855, 856. Cost of jetty, and satisfactory action of, **83**, 857; **86**, 989.

**1883–84.** Repairs by hired labor to jetty, sand fences, and wharf, **84**, 1039.

**1884–85.** Jetty 400 f. long, built on north side of Shackleford Point, 2,300 f. east of main jetty. Main jetty covered with concrete; superstructure 6 f. wide, 3 f. high for a distance of 444 f. Repairs to sea end of main jetty; 721 l. y. of

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[a] H. Doc., No. 482, 55th. Cong., 2d. sess.

[b] Part of $30,000, $5,000 of which was applied to the inland navigation from Beaufort Harbor to New Berne, **83**, 166, 885.

## BEAUFORT HARBOR, N. C.—Continued.

shore revetment laid between main and east jetty. At Macon Point a breach was closed by 420 l. f. of crib-work, a small receiving wharf was constructed, and a jetty started northeast of the fort. Work done by hired labor and purchase in open market. **85**, 1076, 1077; **86**, 990.

**1885–86.** Strengthening jetties at Shackleford Point and placing 100 l. f. of shore protection between the jetties. Extension of jetty No. 1 at Fort Macon Point 120 f.; commencement of jetty No. 2, and rebuilding landing wharf, **86**, 165, 987, 990.

**1886–87.** 1,119 t. of stone placed in works at Fort Macon Point, Cove Sound, and Shackleford Point, **87**, 1032, 1034.

**1887–88.** 271 t. stone placed along 40 f. of surface of main jetty; 8 blocks of concrete added to same; 10 t. stone placed on middle jetty; 595 t. stone added to east jetty; repairs to landing wharf, field quarters, tramroad trestles, and derricks; 31 t. stone and 7 cords brush built into 138 l. f. of shore revetment; 44 t. stone and 22 cords brush built into 488 l. f. of shore revetment, **88**, 877.

**1888–89.** 1,443 t. stone placed in jetties; 10,480 c. y. dredged, **89**, 1071.

**1889–90.** 12,280 c. y. dredged; 5,190 t. rubble stone placed in jetties, **90**, 1134, 1135.

**1890–91.** 280 l. f. of brush and stone revetment built at Shackleford Point, **91**, 1369.

**1891–92.** 9,989 c. y. sand dredged from bar; repairs to sand fences at Fort Macon and Shackleford Point, **92**, 1140.

**1892–93.** 20,585 c. y. dredged, and minor repairs to sand fences in progress, **93**, 1395.

**1893–94.** 7 jetties of brush and stone aggregating 680 f. in length built, 2,384 l. f. sand fences built, 1,328 l. f. repaired, 4,378 l. f. raised, 21,548 l. f. filled under, and refilled under with sand; and 150 f. of oyster-shell dike built, **94**, 1032.

**1894–95.** 5,038 c. y. dredged; 2 jetties of brush aggregating 110 f. in length built; 16 low groins of board palings aggregating 537 f. in length constructed; 9,210 l. f. sand fences built, 15,714 l. f. filled in, and 8,032 l. f. repaired, **95**, 1324.

**1895–96.** 1,056 l. f. sand fences built, 23,332 l. f. raised, and 46,814 l. f. filled in, and 24 l. f. brush jetty constructed in extension of brush jetties and minor repairs made to the latter, **96**, 1116.

**1896–97.** 2,031 l. f. sand fences built, 8,390 l. f. raised, 56,676 l. f. filled in, 3,267 l. f. repaired, and minor repairs made to brush jetties, **97**, 1396.

**1897–98.** 3,041 l. f. sand fences built, 6,865 l. f. raised, 43,164 l. f. filled in, and 5,300 l. f. repaired, **98**, 1247.

**1898–99.** 3,069 l. f. sand fences built, 8,025 l. f. raised, 41,675 l. f. filled under, and 5,680 l. f. repaired, **99**, 1498.

**1899–1900.** 12,376 l. f. sand fences built, 16,626 l. f. raised, 22,916 l. f. filled under and 5,768 l. f. repaired, and 32 l. f. brush jetty repaired, **1900**, 1808.

**Physical characteristics.**

Recession of Shackleford Point, **81**, 1016; **82**, 1094, 1097; **84**, 170; **85**, 168; **86**, 987.

Direction of tidal currents, **82**, 1077.

Change effected by jetty built in 1883, **83**, 1095.

Original condition of the harbor, **88**, 875.

Description of, **94**, 1032, 1033; **95**, 1323; **96**, 1115.

**Projects.**

By Capt. Phillips, 1880, for three jetties of random stone to prevent further abrasion of Shackleford Point, and the dredging of two channels and a turning basin near Beaufort; estimated cost, $82,103.38, **81**, 1013, 1017.

In 1881 Capt. Mercur recommended a system of jetties for protection of Shackleford Point of random stone, about 300 f. long, and spaced about 300 f. apart, **82**, 1095. Plan approved by Board of Engineers, with recommendation that the jetties should be founded upon mattresses, **82**, 1098. Concurred in by the Chief of Engineers and approved by the Secretary of War, **82**, 1096.

In 1884 Capt. Bixby recommended the expansion of the project to cover the protection of Fort Macon Point from erosion, by shore protection and jetties, **85**, 168, 1081. After an expenditure of $75,000 on previous projects, it was estimated in 1886 that $84,000 would be required for the complete protection of Shackleford and Fort Macon points, and the formation of a dredged channel 100 f. wide and 5 f. deep at m. l. w. from Bulkhead Channel to Beaufort, **86**, 989; **87**, 1030; **91**, 1368.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 125, made under direction of Capt. Phillips, 1880, **81**, 1013.

Survey of Shackleford Banks, 1881, **82**, 1094.

List of surveys, **81**, 1015; **82**, 1096; **86**, 989.

MAPS. **83**, 856; 1885, **85**, 1076; **89**, 1072, **90**, 1136; **92**, Atlas, 27, 28, 29, 30; **93**, 1396; **94**, 1032.

**BEAUFORT HARBOR, N. C., NEW RIVER TO (waterway).**
(See also *New River, N. C.*)

**Appropriations.**
1886, $10,000, **87**, 1038.
1888, 5,000, **88**, 883.
1890, 15,000, **90**, 1139.
1892, 10,000, **92**, 1143.
1894, 2,500, **95**, 1326.
1896, 1,000, **96**, 1118.

Total, 43,500

**Commerce.**
Important, **85**, 1134, 1135; **87**, 1037.
Description of, **93**, 1398; **94**, 1034, 1035; **95**, 1325; **1900**, 1810.

**Contracts.**
**1886.** R. Moore, dredging, 32½ cents per c. y., **87**, 1038.
**1889.** Alabama Dredging and Jetty Co., dredging, 40 cents per c. y., **89**, 1075.
**1890.** Alabama Dredging and Jetty Co., dredging, 25 cents per c. y., **91**, 1374.
**1894.** Cordes & Bochman, dredging, 35 cents per c. y., p. m. ($8,500), **95**, 1326.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **84**, 177; **85**, 177; **87**, 129; **88**, 122; **89**, 141; **90**, 127; **91**, 162; **92**, 162; **93**, 175; **94**, 161; **95**, 183; **96**, 165; **97**, 205; **98**, 207; **99**, 239; **1900**, 271.
ENGINEERS IN CHARGE:
Capt. J. Mercur, 1884. Report, **84**, 1055.
Capt. W. H. Bixby, 1885–92. Reports, **85**, 1133, 1135; **87**, 1037; **88**, 882; **89**, 1073; **90**, 1138; **91**, 1373.
Maj. W. S. Stanton, 1892–95. Reports, **92**, 1141; **93**, 1397; **94**, 1034; **95**, 1325.
Lt. Col. D. P. Heap, 1896. Report, **96**, 1117.
Capt. W. E. Craighill, 1897–98. Reports, **97**, 1398; **98**, 1249.
Capt. E. W. Van C. Lucas, 1899—Reports, **99**, 1499; **1900**, 1810.
ASSISTANTS:
J. P. Darling. Reports, **84**, 1055; **85**, 1138.
R. Ransom. Report, **85**, 1134.
E. D. Thompson. Reports, **87**, 1038; **88**, 884; **89**, 1075; **90**, 1140.
W. H. Chadbourne. Reports, **91**, 1375; **92**, 1144.

**Operations.**
**1887–88.** 17,622 c. y. dredged, **88**, 883.
**1888–89.** 35,896 c. y. dredged, **89**, 1074.
**1891–92.** 14,719 c. y. dredged, **92**, 1144.
**1895–96.** 14,650 c. y., p. m., dredged, **96**, 1118.
**1896–97.** 11,041 c. y., p. m., dredged, **97**, 1398.

**Physical characteristics.**
Description of route, **84**, 1055; **85**, 1133, 1136; **94**, 1034; **96**, 1117.
Original condition of the waterway, **88**, 882.

**Plans.** (See *Projects.*)
By Capt. Bixby, 1885, for the formation of dredged channels from 3 to 9 f. deep from White to New rivers. Estimated cost from $78,000 to $540,000. This cost was considered as incommensurate with the benefit to be derived, **85**, 1137.

**Projects.** (See *Plans.*)
By Capt. Bixby, 1885, for the formation of an improved channel by dredging, 3 f. deep at l. w., and extending from Beaufort to Swansboro on the White Oak River; estimated cost, $50,000, **85**, 1138; **87**, 1037.
Aggregate cost of completed project estimated in 1892 at $71,040, **92**, 1142.
By Maj. Stanton, 1892, for withholding $10,000 appropriated in 1892 until experience should show whether it would be needed, **93**, 1398. In 1893–94 this money was applied to dredging a channel 60 f. wide and about 2,000 f. long near Sanders Creek Cut and Turtle Slough, **94**, 1035.

**Surveys.**
Ordered by act of Aug. 2, 1882, made under the direction of Capt. Mercur, 1882, **84**, 1055.
Also by act of July 5, 1884, made under direction of Capt. Bixby, **85**, 1133, 1135.
Minor surveys, **94**, 1035.
Examination made, 1900, by Capt. Lucas, **1900**, 1810.
MAPS.
Bogue Sound and vicinity, **80**, 896; **89**, 1074.

**BEAUFORT HARBOR, N. C., NORTH RIVER TO (water route).**

**Commerce.**
Estimated in 1895 to amount to 935 tons. Owing to the probable cost of the improvement, the unimportant interests, and the small locality that would be benefited, the route was considered unworthy of improvement by the district engineer in 1895. **95**, 1383.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 192.
ENGINEER IN CHARGE. Maj. W. S. Stanton, 1894–95. Report, **95**, 1380.

## BEAUFORT HARBOR, N. C., NORTH RIVER TO (water route)—Continued.

**Physical characteristics.**
Description of, **95**, 1381.

**Surveys.**
Examination from the mouth of North River to the harbor of Beaufort, N. C., ordered by act of Aug. 17, 1894, made, 1895, by Maj. Stanton (report unfavorable), **95**, 1380.

## BEAUFORT RIVER, S. C.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1890, | $12,500, | **91**, | 1486. |
| 1892, | 12,500, | **92**, | 1239. |
| 1894, | 5,000, | **95**, | 1444. |
| 1896, | 1,000, | **96**, | 1209. |
| Total, | 31,000 | | |

**Commerce.**
In 1892–93 the freight moved on the river amounted to 250,000 tons, **93**, 1525; in 1893–94, to 215,000 tons, **94**, 1125; in 1894–95, to 193,985 tons, **95**, 1444; in 1895–96, to 174,300 tons, **96**, 1209.

**Contracts.**
**1890.** T. Young, dredging, 25 cents, and rock excavation, $3.25 per c. y., **91**, 1486.
**1892.** P. S. Ross, dredging, 25 to 34 cents per c. y., rock removal, $2.95 or $3.70 per c. y. ($23,600), **93**, 1526.

**Engineers.**
Chief of Engineers. Reports, **89**, 158; **90**, 141; **91**, 178; **92**, 175; **93**, 189; **94**, 174; **95**, 198; **96**, 176; **97**, 224; **98**, 220; **99**, 254; **1900**, 289.

Engineers in Charge:
Capt. F. V. Abbot, 1889–97. Reports, **90**, 1234; **91**, 1485; **92**, 1238; **93**, 1524; **94**, 1125; **95**, 1443; **96**, 1208; **97**, 1482.
Maj. E. H. Ruffner, 1898–99. Reports, **98**, 1288; **99**, 1548.
Capt. J. C. Sanford, 1900–. Report, **1900**, 1873.
Assistants:
J. P. Allen. Reports, **91**, 1486; **92**, 1239; **93**, 1526; **97**, 1487.
W. D. Niles. Reports, **94**, 1127; **95**, 1446; **96**, 1210.

**Operations.**
**1890–91.** 3,754 c. y. dredged, **91**, 1486.
**1891–92.** 28,512 c. y. dredged, **92**, 1238.
**1892–93.** 36,362 c. y. dredged, and 1,594 c. y. rock removed, **93**, 1526–7.
**1896–97.** 3,732 c. y. dredged, **97**, 1487.

**Physical characteristics.**
Description of, **92**, 1234.

**Plans.** (See *Projects.*)
By Capt. Abbot, 1889, to secure a 15-foot channel 300 f. wide from Beaufort to the ocean, by excavation at Beaufort Shoal, and at shoal near Sea Island Chemical Works, estimated cost $116,000, **1890**, 1236.

**Private work.**
Dredged material which had been illegally dumped by contractor, 1899, removed by him, **1900**, 1873.

**Projects.**
By Capt. Abbot, for improvement of the river at the brickyard near Coosaw mouth, by excavation of a 7-foot low-water channel 200 f. wide; estimated cost, $25,000, **90**, 1236, 1237.
Authority was obtained by Capt. Abbot, 1892–93, to increase the estimate for the completion of the project by $15,000; due to the discovery of a large amount of rock, **93**, 1225, 1229.

**Surveys.**
Ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Abbot, **90**, 1235.
Examination and survey made, 1900, by Capt. Sanford, **1900**, 1873

## BEAUFORT (PORT ROYAL) RIVER, S. C.

**Engineers.**
Chief of Engineers. Report, **80**, 132.

Engineer in Charge. Lt. Col. Q. A. Gillmore, 1880. Report, **80**, 1032.

Assistant. G. Daubeny. Report, **80**, 1034.

**Plans.**
By Lt. Col. Gillmore, 1880: 1. For dredging, Beaufort and at Fort Charlotte, so that a draft of 14 f. can be carried from Port Royal Sound to Beaufort, $9,900. 2. For improving only channel at Fort Charlotte to 200 f. width and 14 f. depth, $5,100. 3. For improving channel at Fort Charlotte to 200 f. width and 13 f. depth, $1,800, **80**, 1033, 1034.

**Surveys.**
Ordered by act of Mar. 3, 1879, **79**, 100, made, 1880, under direction of Lt. Col. Gillmore, **80**, 1032.

## BEAVER BAY, MINN. (Harbor of refuge).

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 247; **82**, 266.

ENGINEER IN CHARGE. Capt. C. J. Allen, 1884. Report, **82**, 2108.

ASSISTANT. S. L. Bayless, **82**, 2109.

**Plans.**

For two crib breakwaters 1,450 l. f. in length; estimated cost, $150,000, **82**, 2109.

**Surveys.**

Ordered by act of Mar. 3, 1881, made, 1881, under the direction of Capt. Allen, **82**, 2108.

## BEAVER ISLAND, IOWA. (See *Mississippi River.*)

## BEECHRIDGE, ILL. (See *Mississippi River.*)

## BEE TREE SHOALS. (See *Tennessee River.*)

## BELFAST BAY AND HARBOR, ME.

**Appropriations.**

1826, $1,200, act May 20.
1876, 5,000, **77**, 34.
1878, 12,000, **78**, 38.
1879, 5,000, **79**, 45.
1880, 3,000, **80**, 330.
1890, 10,000, **90**, 435.
1892, 10,000, **92**, 508.
1894, 8,000, **95**, 552.
1896, 8,000, **96**, 554.

Total, 62,000

**Commerce.**

Benefit of improvement, **76**, 194; **77**, 161.

Commercial advantages of Belfast, **76**, 194.

Coal and freight traffic, **88**, 381.

**Contracts.**

**1877.** J. M. Andrews, rock excavation, **77**, 161.

**1878.** Atlantic Dredging Co., dredging, 38 cents per c. y., **79**, 251.

**1892.** Hamilton & Sawyer, dredging, 23 cents per c. y. ($13,800), **93**, 688.

**1895.** Hamilton & Sawyer, dredging, 14¾ cents per c. y., s. m. ($7,375), **95**, 552.

**1896.** Hamilton & Sawyer, dredging, 13⅞ cents per c. y., s. m. ($7,215), **97**, 781.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 48; **77**, 34; **78**, 37; **79**, 45; **80**, 64; **81**, 65; **82**, 65; **83**, 60; **84**, 69; **85**, 57; **86**, 56; **87**, 16; **88**, 14; **89**, 23, 31; **90**, 18, 26; **91**, 23; **92**, 28; **93**, 26; **94**, 26; **95**, 27; **96**, 30; **97**, 32.

ENGINEERS IN CHARGE:

Lt. Col. G. Thom, 1876–85. Reports, **76**, 190; **77**, 159; **78**, 194; **79**, 250; (Col.), **80**, 330; **81**, 463; **82**, 491; **83**, 412; **84**, 463.

Col. C. E. Blunt, 1885–86. Report, **85**, 467.

Maj. J. A. Smith, 1886–91. Reports, **86**, 535; **87**, 445; (Lt. Col.), **88**, 381; **89**, 522; **90**, 435, 455; **91**, 586.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 507; **93**, 687; **94**, 503.

Lt. Col. D. P. Heap, 1895. Report, **95**, 551.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 553.

Maj. R. L. Hoxie, 1897. Report, **97**, 781.

ASSISTANT. A. C. Both. Reports, **76**, 191; **90**, 456.

**Estimates.** (See also *Projects.*)

By A. C. Both, for construction of breakwater, $310,000, **76**, 191, 193.

**Operations.**

**1877–78.** Portions of ledge off Lane's wharf removed, **78**, 194.

**1878–79.** Dredging of shoal to depth of 10 f. at m. l. w., **79**, 251.

**1879–80.** Removal of shoal in front of wharves by use of hired dredge and plant, **80**, 330. Completion of project of 1877, at a cost of $22,000, **80**, 65, 331.

**1885–86.** Wreck of schooner *Waldemar* removed, **86**, 536.

**1892–93.** About 28,000 c. y. dredged, **93**, 688.

**1893–94.** About 12,000 c. y. dredged, **94**, 504.

**1894–95.** Channel at entrance dredged to full width, and part of the harbor dredged, **95**, 552.

**1895–96.** In connection with work of previous year, about 50,000 c. y. dredged, **96**, 554.

**1896–97.** Project completed, **97**, 781.

**Physical characteristics.**

General, **76**, 190. Tides, **76**, 190. Obstructions: shoal, and a sunken ledge, **76**, 190, 192.

**Plans.**

By A. C. Both, for construction of a breakwater between McGilvery's shipyard and Pattersons Point, in two sections, one running from each place, toward each other, 1,500 f. and 900 f. in length, leaving an opening of 800 f. between the outer ends; piers to be 10 f. wide on top and 14 f. above m. l. w., **76**, 190, 192.

## BELFAST BAY AND HARBOR, ME.—Continued.

By Col. Thom, 1880, for the construction of a jetty from north shore of harbor to direct tidal currents; estimated cost, $18,000, **80**, 331.

**Projects.**

The original project was by Col. Thom, 1877, for deepening, by dredging to a depth of 10 and 12 f., the area between the wharves and deep water in the river, **76**, 190. Completed in 1880 at a cost of $22,000, **80**, 65, 531.

Lt. Col. Smith, 1888, proposed to increase the depth on the northeast side of the present harbor to 8 f., by the removal of 52,000 c. y. of material, estimated cost, $12,850, **88**, 382. After an examination and survey in 1889, Lt. Col. Smith submitted a project for dredging a part of the main channel to give a depth of 15 f., and a least width of 220 f., and deepening portions of the east and west sides to 8 and 13 f., respectively, at m. l. w.; estimated cost, $52,000, **90**, 18, 435, 456; **91**, 586; **92**, 508.

**Surveys.**

By A. C. Both, 1875. Report, **76**, 191.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Smith (see *Projects*), **90**, 435, 455.

MAPS. **80**, 330.

## BELLAIRE, OHIO (ice harbor). (See *Ohio River.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 195; **81**, 263.

ENGINEER IN CHARGE. Maj. W. E. Merrill, 1881. Report, **81**, 1951.

ASSISTANT. J. H. Harlow. Report, **81**, 1952.

**Plans.**

By Maj. Merrill, 1881, for the protection of the landing against ice by the construction of two crib-piers intermediate between the present piers in the railroad bridge; estimated cost, $7,500, **81**, 1951, 1953.

**Surveys.**

Ordered by act of Mar. 3, 1879, **80**, 195, made under direction of Maj. Merrill, 1881, **81**, 1951.

## BELLAMY RIVER, N. H.

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $10,000, | **88**, 20. |
| 1890, | 10,000, | **90**, 453. |
| 1892, | 7,500, | **92**, 529. |
| 1894, | 7,500, | **95**, 572. |
| Total, | 35,000 | |

**Contracts.**

**1888.** T. Symonds, dredging, 19¾ cents per c. y., **89**, 542.

**1890.** A. B. Martin, dredging, 25 cents per c. y., **91**, 607.

**1895.** Columbian Dredging Co., dredging, 23 cents per c. y., s. m. ($16,100), **95**, 572.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 22; **88**, 20; **89**, 29; **90**, 25; **91**, 30; **92**, 36; **93**, 34; **94**, 34; **95**, 35; **96**, 39; **97**, 40.

ENGINEERS IN CHARGE:

Maj. J. A. Smith, 1886–92. Reports, **87**, 484, 485; (Lt. Col.) **89**, 540; **90**, 452; **91**, 605.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 528; **93**, 716; **94**, 523.

Lt. Col. D. P. Heap, 1895. Report, **95**, 571.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 575.

Maj. R. L. Hoxie, 1897. Report, **97**, 794.

ASSISTANT. F. S. Burrows. Report, **87**, 486.

**Operations.**

**1888–89.** 22,700 c. y. dredged, **89**, 541.

**1889–90.** 21,650 c. y. dredged, **90**, 452.

**1890–91.** Dredging continued, **91**, 606.

**1892–93.** 35,997 c. y. dredged, **93**, 716.

**1895–96.** 46,409 c. y. dredged, **96**, 576.

**1896–97.** About 12,000 c. y. dredged (project completed), **97**, 794.

**Projects.**

By Maj. Smith, 1887, for improvement of the river for a distance of 2½ miles by dredging a channel 50 f. wide and 5 f. deep at m. l. w. from mouth to head of navigation; estimated cost, $28,000, **87**, 486; **89**, 541. Increased in 1891 to $35,000, **91**, 606; **92**, 528.

**Surveys.**

Examination and survey ordered by act of Aug. 5, 1886, made, 1887, under direction of Maj. Smith, **87**, 484, 485.

## BELLE PLAINE, MINN. (See *Minnesota River, Minn.*)

## BELLE RIVER, MARINE CITY, MICH. (Including ice harbor of refuge.)

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $7,000, | **81,** 2253. |
| 1882, | 5,000, | **83,** 1875. |
| 1884, | 2,000, | **85,** 2159. |
| 1895, | 5,000, | **97,** 3026. |
| 1899, | 10,000, | **99,** 2997. |
| Total, | 29,000 | |

**Commerce.**

Danger to shipping from movement of ice in river, **80,** 2060.

Necessity for protection against ice, **80,** 2060, 2062.

Description of; increasing, **93,** 2957.

**Contracts.**

**1881.** Carkin, Stickney & Cram, dredging, 13 cents per c. y., **81,** 2253.

**1882.** T. M. Hubbell, dredging, 16 cents per c. y., **83,** 1876.

**1885.** T. M. Hubbell, dredging, 20 cents per c. y., **85,** 2159.

**1899.** J. Rooney, dredging, 9½ cents per c. y., s. m., **1900,** 3992.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80,** 221; **81,** 299; **82,** 294; **83,** 303; **84,** 306; **85,** 329; **86,** 324; **87,** 291; **93,** 388; **95,** 348, 351; **96,** 397; **97,** 448, **98,** 435; **99,** 517; **1900,** 582.

ENGINEERS IN CHARGE:

Maj. F. Harwood, 1880–82. Reports, **80,** 2059; **81,** 2252; **82,** 2335.

Maj. F. N. Farquhar, 1882–83. Report, **83,** 299.

Lt. Col. O. M. Poe, 1883–88. Reports, **83,** 1875; **84,** 2070; **85,** 2157; **86,** 1837; **87,** 2262; **88,** 1972.

Maj. W. Ludlow, 1893. Report, **93,** 2956.

Lt. Col. G. J. Lydecker, 1895. Reports, **95,** 2745; **97,** 3025; **98,** 2589; **99,** 2996; **1900,** 3991.

ASSISTANT. B. H. Muehle. Report, **93,** 2957.

**Operations.**

**1881–82.** 40,873 c. y. dredged between mouth of river and first bridge, **82,** 2335.

**1882–83.** 28,235 c. y. dredged between first and second bridges, **83,** 1875.

**1884–85.** 8,100 c. y. dredged, completing project, **85,** 2158; **87,** 2262; **88,** 1972.

**1896–98.** 39,035 c. y., s. m., dredged, **98,** 2590.

**1899–1900.** 52,074 c. y. dredged, **1900,** 3991.

**Physical characteristics.**

Description of; a small stream 125 to 150 f. wide entering the St. Clair River, **97,** 2957.

**Projects.**

By Maj. F. Harwood, 1880, for a channel 50 f. wide and 13 f. deep from the mouth of the river to Marine City drawbridge, thence to second bridge, 12 f. deep; estimated cost, $14,465, **80,** 2060; **83,** 1875. Project completed in 1885 at a cost of $14,000, **85,** 2158; **87,** 2262.

Lt. Col. Lydecker estimated, 1895, it would cost $21,340 to improve the stream, **95,** 2746; by redredging the river from its mouth to the second bridge above, the channel to be 75 f. wide and 15 f. deep to the first bridge, thence 14 f., **97,** 3026.

**Surveys.**

Ordered by act of Mar. 3, 1879, made under direction of Maj. Harwood, 1880, **80,** 2059.

Examination from mouth to Broadway Street bridge ordered by act of July 13, 1892, made under direction of Maj. Ludlow, 1893 (report favorable), **93,** 2956.

Survey ordered by act of Aug. 17, 1894, made by Lt. Col. Lydecker, 1895 (see *Projects*), **95,** 2746.

Minor surveys, **99,** 2996.

MAPS. 1882, **82,** 2336.

## BELLEVUE, IOWA. (See *Mississippi River.*)

## BELLINGHAM BAY, WASH. (See *Nooksack River; Skagit River, Wash.*)

**Commerce.**

Description of, **95,** 3473; **97,** 3479.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95,** 457; **97,** 523.

ENGINEERS IN CHARGE:

Capt. T. W. Symons, 1895. Report, **95,** 3472.

Capt. H. Taylor, 1897. Report, **97,** 3478.

ASSISTANT. J. M. Clapp. Report, **97,** 3480.

**Physical characteristics.**

Description of, **95,** 3472.

The bay is a part of Puget Sound, reaching to 15 miles of the international boundary. It is about 10 miles long from north to south and about 5 miles wide. It is distinguished from most of the Sound harbors in that it is shallow enough to afford an anchorage. Starr Rock is situated in the path of the commerce between two cities on the bay. **95,** 3472, 3473.

New Whatcom, one of the cities referred to above, is at the northern end of the bay, and is the largest city on Puget Sound north of Seattle, **97,** 3479.

### BELLINGHAM BAY, WASH.—Continued.

**Projects.**
In 1897 Capt. Taylor estimated it would cost $80,000 to make an improvement at Whatcom Creek, **97**, 3480.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made, 1895, by Capt. Symons (report favorable only to Starr Rock removal), **95**, 3472.

Survey of the bay from deep water to mouth of Whatcom Creek ordered by act of June 3, 1896, made, 1897, under direction of Capt. Taylor (report favorable) (see *Projects*), **97**, 3478.

### BENNETT CREEK, VA.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 120.

ENGINEER IN CHARGE. Lt. G. J. Fiebeger, 1889. Report, **89**, 971.

ASSISTANT. T. I. George. Report, **89**, 972.

**Physical characteristics.**
Description of, **89**, 972.

**Surveys.**
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Fiebeger (report unfavorable), **89**, 971.

### BENTON HARBOR AND CANAL, MICH. (See *St. Josephs River, Mich.*)

### BERGEN NECK, N. J., SHIP CANAL ACROSS.

**Commerce.**
Important, **80**, 533.

**Engineers.**
CHIEF OF ENGINEERS. Report, **80**, 85.

ENGINEER IN CHARGE. Lt. Col. J. Newton, 1880. Report, **80**, 529.

ASSISTANT. R. H. Talcott. Report, **80**, 530.

**Physical characteristics.**
Described, **80**, 531. Tidal obstructions, **80**, 531.

**Plans.**
By Lt. Col. Newton, 1880, for connecting Newark Bay with upper New York Bay by a canal 4,500 f. long, 12 f. deep at m. l. w., 200 f. wide at bottom; estimated cost, exclusive of land damages, $3,332,426.88, **80**, 530, 532.

**Private, State, and corporate work.**
Morris Canal crosses Bergen Neck at site proposed for ship canal, **80**, 531.

**Surveys.**
Ordered by act of Mar. 3, 1879, **79**, 66, 1879, made under direction of Col. Newton, 1880, **80**, 530.

MAPS. **80**, 530.

### BERGEN POINT. (See *Hudson River.*)

### BERRIANS CREEK, LONG ISLAND, N. Y.

**Commerce.**
Description of. Estimated to amount to 160,000 ts. annually. Commerce would probably be doubled by an improvement of the stream. **93**, 994.

**Engineers.**
CHIEF OF ENGINEERS. Report, **93**, 92.

ENGINEER IN CHARGE. Lt. Col. H. M. Robert, 1893. Report, **93**, 993.

**Physical characteristics.**
Description of.

At ordinary low tide the bed of the creek is nearly bare everywhere, **93**, 994.

**Surveys.**
Examination ordered by act of July 13, 1892, made by Col. Houston, 1892 (report unfavorable), **93**, 993.

### BERRY LAKE, IND.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 293.

ENGINEER IN CHARGE. Capt. W. L. Marshall, 1889. Report, **89**, 2157.

**Physical characteristics.**
Description of, **89**, 2157.

**Surveys.**
Examination for harbor of refuge ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Marshall (report unfavorable), **89**, 2157.

### BERWICK BAY, LA. (See *Mississippi River.*)

**Engineers.**
CHIEF OF ENGINEERS. Report, **91**, 229, 1847.

ENGINEER IN CHARGE. Capt. W. L. Fisk. Report, **91**, 1848.

**Surveys.**
Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Fisk (report unfavorable), **91**, 1848.

## BERWICK BRANCH. (See *Piscataqua River, Me. and N. H.*)

## BEVERLY HARBOR, MASS.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 44; **90**, 38; **99**, 81; **1900**, 77, 78.

ENGINEERS IN CHARGE:

Lt. Col. S. M. Mansfield, 1890. Report, **90**, 524.

Col. C. R. Suter, 1900. Report, **1900**, 1182.

ASSISTANT. T. T. Hunter Harwood. Report, **90**, 526.

**Physical characteristics.**

Description of, **90**, 524; **1900**, 1183.

**Plans.**

By Lt. Col. Mansfield, 1889, for improvement of the harbor entrance by removal of obstructing rock opposite Tucks Point, **90**, 525.

**Surveys.**

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Mansfield, **90**, 525.

Examination ordered by act of Mar. 3, 1899, made, 1899, by Col. Suter (report unfavorable), **1900**, 1183.

## BIDDLES POINT, MACKINAC HARBOR, MICH. (See *Mackinac City, Mich., survey for breakwater at.*)

## BIG BARREN RIVER, KY., extension of slack-water improvement. (See *Green River.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 310, 2474.

ENGINEER IN CHARGE. Maj. D. W. Lockwood, 1890. Report, **91**, 2475.

ASSISTANT. Lt. W. L. Sibert. Report port, **91**, 2476.

**Physical characteristics.**

Description of, **91**, 2475.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Lockwood (report unfavorable), **91**, 2475.

## BIG BAYOU METRE (METO), ARK. (See *Metre (Meto) Bayou, Ark.*)

## BEAR CREEK, MISS. (See *Tennessee River, Ala., Miss.*)

## BIG BEAR CREEK, MISS. (See *Bear Creek, Miss.*, and *Black Warrior, Warrior*, and *Tombigbee Rivers, Ala. and Miss.*, Part A.)

## BIG BEAR RIVER, MISS. AND TENN. (See *Big Bear Creek, Miss.*)

## BIG BEAVER RIVER, PA. (See *Ohio Canal.*)

## BIG BLACK RIVER, MISS.

**Appropriations.**

1884, $5,000, **85**, 1525.
1886, 5,000, **86**, 1365.
1892, 5,000, **92**, 1622.

Total, 15,000

**Commerce.**

Small, **93**, 2023.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 213; **82**, 210; **85**, 241; **86**, 236; **87**, 198; **88**, 181; **89**, 212; **90**, 191; **91**, 242; **92**, 234; **93**, 264; **94**, 244; **95**, 273.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1881–82. Report, **82**, 1565.

Capt. E. Bergland, 1884–86. Reports, **85**, 1524; **86**, 1365.

Capt. J. H. Willard, 1886–95. Reports, **87**, 1465; **88**, 1356; **89**, 1608; **90**, 1890; **91**, 1993; **92**, 1622; **93**, 2022; **94**, 1482; **95**, 1926.

ASSISTANTS:

W. S. Davis. Report, **82**, 1566.
W. Porterfield. Report, **85**, 1525.

**Legislation.**

Act of legislature of Mississippi to remove bridges obstructing navigation, **88**, 1357.

**Obstructions.**

Bridges without draws obstructing navigation, **82**, 1566; **85**, 241, 1524; **86**, 236.

No further work to be done till the State should remove obstructing bridges, **87**, 1466.

## BIG BLACK RIVER, MISS.—Continued.

Permanent iron swing bridge, erected 1892–93 in place of fixed wooden bridge at Baldwins Ferry, as approved by the Secretary of War, **93**, 2023.

**Operations.**

**1884–85.** Obstructions removed from mouth to 75 miles above, **85**, 1524, 1527.

**1890–91.** 101 snags and logs, jams, and 2 drifts cleared from the channel; 1 brush wing dam built, and 13,403 leaning trees cleared from the banks, **91**, 1994.

**1894–95.** Old wreck removed, some stone blasted from channel, 1,059 s. y. brush and willows cut, and nearly 100,000 obstructions destroyed, **95**, 1929.

**Physical characteristics.**

Description of, **82**, 1567; **95**, 1927.

**Projects.**

By Maj. Benyaurd, 1881, for removing logs, snags, and similar obstructions from the river between the mouth and Coxs Ferry, 130 miles; estimated cost, $32,000, **82**, 1566, 1570; **87**, 236. After partial completion of the project under the appropriation of 1884, the appropriation of 1886 was made conditional upon the removal of certain bridges over the river. In 1888, in view of the fact that the maintenance of the bridges was regarded as of greater practical benefit and importance than the improvement of the river, Capt. Willard recommended that no further appropriations be made, **88**, 1356.

Works not permanent, **95**, 1929.

**Surveys.**

Examination ordered by act of June 14, 1880, made under direction of Maj. Benyaurd, 1881, **82**, 1565.

Examination under direction of Capt. Willard made, 1894, **95**, 1927.

## BIG COAL AND LITTLE COAL RIVERS, W. VA.

**Commerce.**

Unimportant, **95**, 2466.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 253; **95**, 336.

ENGINEERS IN CHARGE:

Lt. Col. W. P. Craighill, 1887–94. Reports, **87**, 1929; (Col.)**95**, 2465.

Lt. Col. P. C. Hains, 1895. Report, **95**, 2465.

ASSISTANT. W. C. Reynolds. Report, **87**, 1929.

**Physical characteristics.**

Description of, **87**, 1929.

Little Coal River a branch, **95**, 2465.

**Surveys.**

Examination ordered by act of Oct. 4, 1886, made, 1887, under direction of Lt. Col. Craighill (report unfavorable), **87**, 1929.

Examination ordered by act of Aug. 17, 1894, made in that year by Col. Craighill (report unfavorable), **95**, 2465.

## BIG ELK RIVER. (See *Yaquina and Big Elk River, Oreg.*)

## BIG HATCHEE RIVER. (See *Hatchee River.*)

## BIG HOCKING RIVER, OHIO.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 244; **88**, 218; **92**, 277.

ENGINEERS IN CHARGE:

Lt. Col. W. E. Merrill, 1887–88. Reports, **87**, 1835; **88**, 1719, 1720.

Maj. A. Stickney, 1892. Report, **92**, 1964.

ASSISTANTS:

Lt. L. H. Beach. Reports, **87**, 1835; **88**, 1720, 1721.

E. Moeser. Report, **92**, 1964.

**Operations.**

**1891–92.** 627 c. y. stone and 48 logs removed from the channel, **92**, 1964.

**Physical characteristics.**

Description of, **88**, 1720.

**Plans.**

By Lt. Col. Merrill, 1887, for improving river, mouth to Coolville, 5 miles, securing a navigation for light-draft boats during the medium and higher stages, by removing overhanging trees and similar obstructions; estimated cost, $5,000, **88**, 1720.

**Surveys.**

Examination mouth to Coolville, ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. Merrill (report favorable), **87**, 1835; **88**, 1720.

## BIG RAPIDS, ME. (See *St. Johns River.*)

## BIG SANDY CREEK, N. Y.[a] (See *Sandy Creek, N. Y.*)

## BIG SANDY RIVER, KY. AND W. VA.

| Part. | Appropriations. |
|---|---|
| A.—Big Sandy River (See also Parts B and C) | $775,311.96 |
| B.—Levisa Fork | 5,500.00 |
| C.—Tug Fork | 6,000.00 |
| Total | 786,811.96 |

### Part A.—Big Sandy River, Ky. and W. Va.

**Appropriations.**

| | | |
|---|---|---|
| 1878, | $12,000.00, | **78**, 108. |
| 1879, | 12,000.00, | **79**, 146, 1355. |
| 1880, | [b] 55,000.00, | **80**, 1829. |
| 1881, | [b] 50,000.00, | **81**, 1982. |
| 1882, | [b] 25,000.00, | **82**, 259. |
| 1884, | [b] 50,000.00, | **84**, 1751. |
| 1886, | [b] 30,000.00, | **86**, 1619. |
| 1888, | 31,500.00, | **88**, 1788. |
| 1890, | [c] 31,000.00, | **90**, 2275. |
| | [d] 2,500.00, | **90**, 2466. |
| | [e] 2,500.00, | **91**, 2468. |
| 1892, | [c] 50,000.00, | **92**, 2100. |
| | [d] 2,500.00, | **92**, 2109. |
| | [e] 2,500.00, | **92**, 2111. |
| 1894, | 40,000.00, | **95**, 2500. |
| 1896, | 17,811.96, | act, May 1, 1896. |
| 1896, | 30,000.00, | **96**, 2302. |
| 1899, | 50,000.00, | **99**, 2502. |
| 1900, | 280,000.00, | **1900**, 3348. |
| 1900, | [f] 1,000.00, | **1900**, 498. |
| Total, | 775,311.96 | |

**Commerce.**

Products of valley, **75**, 761, 763; **76**, ii, 143. Commerce of Levisa Fork unimportant, **76**, ii, 140. Commerce limited to rafting, **76**, ii, 142.

Description of, **96**, 2301.

Since the United States commenced the improvement of the river and its forks, the commerce, at 1896, had doubled, to value of $39,910,000, **96**, 2301.

In 1898, the great natural resources of the country with its enormous coal deposits awaited development by transportation facilities, **98**, 2160.

Report by Prof. C. Newton on mineral wealth of the Big Sandy Valley from Levisa to the head of navigation, **1900**, 3413.

**Contracts.**

**1883.** D. B. Shipley, delivery of stone for lock, **84**, 1749.

**1891.** Marting, Mittendorf & Duis, oak timber, $10,977, **91**, 2464. G. Kinsey & Co., ironwork, $963.44, **91**, 2464.

**1893.** G. Kinsey & Co., ironwork: cast iron, 2¾ cents per lb.; wrought iron, 3$\frac{9}{10}$ cents per lb., **93**, 2633.

**1896.** J. P. McGuire, furnishing and delivering about 31 steel trestles, 35,250 lbs., at 4$\frac{27}{47}$ cents per lb., **97**, 2532.

**1900.** J. C. Thomas, construction of lock No. 1, $116,455 and $122,675, **1900**, 3349.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 73; **76**, 90; **78**, 108; **79**, 145; **80**, 196; **81**, 264; **82**, 258; **83**, 266; **84**, 265, 267; **85**, 290; **86**, 284; **87**, 241, 249; **88**, 227, 229; **89**, 265, 267; **90**, 239; **91**, 307, 308, 310; **92**, 293, 294, 2101; **93**, 332, 336; **94**, 305; **95**, 340; **96**, 297; **97**, 377; **98**, 369, 373; **99**, 433; **1900**, 496, 503.

BOARDS OF ENGINEERS:

Convened at Louisa, Ky., Nov. 10, 1891, by S. O. No. 31, to report upon the subject of a dam to be built in the Big Sandy River near Louisa, Ky. Report, **92**, 2102. (Col. Craighill, Maj. Lockwood, and Capt. Turtle.)

Convened at Cincinnati, Ohio, Apr. 3, 1896, by S. O. No. 11. O, C. E., dated Mar. 12, 1896, to consider and report upon proposed modifications in the details for the construction of the movable dam at Louisa, Ky. Report, **96**, 2302. (Lt. Col. A. Stickney, Maj. J. F. Gregory, Capt. H. M. Chittenden, and Lt. W. W. Harts.) Minority report, **96**, 2306. (Maj. D. W. Lockwood and Lt. W. E. Craighill.)

ENGINEERS IN CHARGE:

Maj. W. E. Merrill, 1875–80; **75**, 73; **76**, ii, 90. Reports, **75**, 756; **76**, ii, 140; **79**, 1353; (Lt. Col.) **80**, 195.

Maj. J. W. Cuyler, 1880–83. Reports, **80**, 1827; **81**, 1979; **82**, 1952; **84**, 1755.

Capt. J. C. Post, 1883–87. Reports, **83**, 1564; **84**, 1749; **85**, 1884; **86**, 1618; **87**, 1902.

Lt. Col. W. E. Merrill, 1887. Report, **87**, 1823.

Maj. D. W. Lockwood, 1888–95. Reports, **88**, 1786, 1795, 1796; **89**, 1983; **90**,

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[a] Survey.—Report, Jan. 22, 1829, estimate, $36,465.30. (H. Doc. No. 482, Fifty-fifth Cong., 2d sess.)
[b] Portions for Levisa and Tug forks. [c] Big Sandy River. [d] Levisa Fork. [e] Tug Fork.
[f] Allotment.

## BIG SANDY RIVER, KY. AND W. VA.—Continued.

### Part A.—Big Sandy River, Ky. and W. Va.—Continued.

2274; **91**, 2463, 2466, 2467, 2476; **92**, 2098, 2108, 2109; **93**, 2631, 2647; **94**, 1992; **95**, 2498.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2300; **97**, 2530.

Maj. W. H. Heuer, 1897.

Maj. W. H. Bixby, 1898–99. Reports, **98**, 2143, 2159.

Capt. H. F. Hodges, 1899– . Reports, **99**, 2501; **1900**, 3347, 3403.

ASSISTANTS:

J. E. Bell, **75**, 756; **76**, ii, 140. Reports, **75**, 760; **76**, ii, 140.

E. A. Chase. Reports, **80**, 1829; **81**, 1982; **82**, 1953; **83**, 1567.

B. C. Howell. Report, **84**, 1751.

B. F. Thomas. Reports, **85**, 1886; **87**, 1824; **88**, 1789; **89**, 1985; **90**, 2276; **91**, 2465, 2467, 2468, 2478; **92**, 2100; **93**, 2633; **94**, 1994; **95**, 2500; **96**, 2318; **97**, 2532; **98**, 2149, 2164; **99**, 2504; **1900**, 3351, 3403.

History of the work, and description of proposed modifications in the construction of the dam, **96**, 2310.

Detailed description of the lock and needle dam near Louisa, Ky., history of its construction, statement of cost, and explanation of the methods employed to operate it, **97**, 2534.

M. W. Venable. Report, **88**, 1797.

Estimate of cost of lock and dam had it been constructed under favorable conditions, **97**, 2559.

D. A. Watt. Calculations for trestles and needles of the dam, **97**, 2558.

**Operations.**

**1878–79.** Improvement of river between Louisa and Catlettsburg, and on each of the forks. Above Louisa, by the removal of 6,758 snags, 4,257 fallen trees, 4,098 cords of drift, and 4,013 c. y. rocks removed from channel. **79**, 146, 1353.

**1879–80.** Logs, snags, fallen trees, loose and solid rock removed. **80**, 1827, 1830.

**1880–83.** Obstructions removed, **81**, 1984; **82**, 1954; **83**, 1564, 1569; summary of results accomplished, **83**, 1655. Improvement of the natural channels resulting in a channel 50 f. wide and 2 f. deep from Louisa, 100 miles up the Levisa Fork, and a similar channel in Tug Fork for 108 miles, **83**, 1565.

**1883–84.** Obstructions removed from 36 miles of Levisa Fork, 2,768 c. y. of stone for lock delivered; 2,132 c. y. rock and 1,623 c. y. of earth removed from foundation of lock, **84**, 1750, 1751.

**1884–85.** Obstructions removed from 26 miles of the Big Sandy, 87 miles of Levisa Fork, and 58 miles on Tug Fork; excavation at lock site and completion of nearly two-thirds of the lock masonry, **85**, 1885.

**1885–86.** Completion of masonry for lock, **86**, 1618.

**1886–87.** Progress on foundation for abutment and excavation of the approaches to the lock, 1,603 trees and snags and 6,608 c. y. of rock removed from Levisa and Tug forks, **87**, 1823, 1825.

**1887–88.** Abutment for dam at Louisa completed and upstream lock entrance blasted out; 1,050 l. f. of protection wall built at Big White House Shoal on Levisa Fork; 455 trees and snags and 57 c. y. rock cleared from the channel below Louisa; 880 snags and 1,744 c. y. rock removed from Levisa Fork; 150 snags and 2,533 c. y. rock cleared from Tug Fork, **88**, 1789, 1790.

**1888–89.** 2,000 c. y. rock excavated from lock site at Louisa; 372 snags, 88 trees, 142 c. y. solid and 376 c. y. loose rock removed from the river below Louisa, **89**, 1985.

**1889–90.** Lock at Louisa completed, **90**, 2275.

**1890–91.** Abutment graded and portion of dam next the abutment completed, **91**, 2463; 550 trees, snags, and stumps, 230 c. y. solid and 1,523 c. y. loose rock removed from Levisa Fork, **91**, 2466; 70 c. y. rock and 463 snags cleared from the channel, and 625 trees and stumps topped and removed from the banks of Tug Fork, **91**, 2469.

**1891–92.** Work on dam in Big Sandy River suspended, pending a decision in regard to the style of dam; 375 snags, logs, and trees, cleared from the channels and 120 c. y. rock blasted from points in the river, **92**, 2,100; 320 c. y. solid and 1,310 c. y. loose rock and 816 snags, logs, and trees removed from Levisa Fork, **92**, 2109; 80 c. y. solid and 2,147 c. y. loose rock and 1,134 snags and stumps removed from Tug Fork, **92**, 2111.

**1892–93.** Lock modified to suit the change from a fixed to a movable dam; entrance to lock deepened; shore cribs constructed above and below the lock; Kentucky bank protected by riprapping; and cofferdam partly constructed to inclose the site of the pass and part of the movable dam, **93**, 2632.

**1893–94.** Cofferdam completed; masonry of pass completed ready to receive trestles; and pier partly constructed and part of old abutment removed, **94**, 1994, 1998.

**1894–95.** Masonry foundations of needle dam, pier and abutment completed; banks on both sides of the river

## BIG SANDY RIVER, KY. AND W. VA.—Continued.

### Part A.—Big Sandy River, Ky., and W. Va.—Continued.

graded, riprapped, and paved; and old waste piles in bed of river removed, **95**, 2500–2502.

**1895–96.** Two lock houses in course of completion; banks about lock and dam riprapped and paved; and designing of movable parts of dam in progress, **96**, 2318, 2319.

**1896–97.** Lock gates constructed and placed in position; trestles placed in position in weir and navigation pass; means for lowering and raising the dam provided; and dam operated for the first time on Jan. 1, 1897, **97**, 2532–2534.

**1897–98.** Work of minor importance performed, **98**, 2149.

**1898–99.** Lock grounds drained, gauges placed, old crib removed and replaced by a stone wall, and minor work done, **99**, 2501.

**1899–1900.** Miscellaneous work done, **1900**, 3352.

**Physical characteristics.**

Length of river and tributaries, **75**, 756, 760, 762; **76**, ii, 140, 142.

Description of river and valley, **75**, 760; **76**, ii, 141.

Fall of river, **75**, 756, 760, 766; **76**, ii, 140, 142, 145. Width of, **75**, 761; **76**, ii, 141. Discharge of, **75**, 761; **76**, ii, 142. (See *Operations, 1880–83.*)

Geology of basin, **75**, 763.

Description of, **88**, 1787; **89**, 1990; **93**, 2631; **94**, 1992; **95**, 2498; **96**, 2300, 2304; **97**, 2537, 2541.

Description of. Formed by confluence of Levisa and Tug forks, 26 miles from its mouth. Flows through a narrow valley between rocky hills, and empties into the Ohio at Catlettsburg. The Ohio is so low at times that it is unable to carry away the material brought down by the Big Sandy, which causes the formation of this material into a bar at the mouth of the latter stream, **93**, 2647, 2648. Its bottom lands not generally subject to overflow; its banks are composed of fine sand generally. Its many tributaries are sediment-bearing in rainy weather. **98**, 2160.

Description of, Big Sandy River, Levisa Fork, and Tug Fork, **1900**, 3407, 3409, 3411.

Description of, Levisa Fork, **88**, 1796.

Description of, Tug Fork, **91**, 2467.

Description of, Russel Fork, **91**, 2478.

The character of the material excavated for the dam, some of it being coal, such that additional work was required, **94**, 1993, 2000; **97**, 2543.

The bed of the river slowly rising, due to the influx into it of material from various sources, **95**, 2499; **96**, 2301, 2312.

Freshets, **96**, 2312.

Gauge readings, **96**, 2318.

Discharge observations, **97**, 2539.

Large quantities of drift a menace to the trestles, **98**, 2145.

Description of sites of locks Nos. 1 and 2, **1900**, 3347.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Merrill, 1875, for improvement to depth of 4 f., by slack-water navigation—locks and dams—from mouth to Louisa Fork, 26 miles; thence by Louisa Fork to Piketon, 86½ miles. Also improvement of Tug Fork, from Louisa to Warfield, 35 miles, requiring 22 locks and dams; locks 200 f. by 45 f.; lift about 10 f.; dams of timber cribs filled with stone; estimated cost, $1,922,536, **75**, 757, 759. Temporary improvement from removal of obstructions, $15,000, **75**, 759.

Examination, 1876, unfavorable to improvement of Levisa Fork by locks and dams, **76**, ii, 140, 144.

By Lt. Col. Merrill, 1878, for the improvement of the natural channels; to better the raft and push-boat navigation, to be followed by a slack-water navigation; to afford a permanent 5-f. navigation with locks and dams; at estimated cost of $1,937,536, **75**, 757; **79**, 1355.

In 1880 Maj. Cuyler proposed the construction of the first lock and dam at Louisa, Ky., at an estimated cost of $110,000, **80**, 1828; **81**, 1981. In 1883 this estimate increased to $213,237.39, **83**, 1565.

In 1887 Maj. Post reported that at a cost of $5,750 the Levisa Fork could be improved from the Virginia State line to Dismal Swamp, improving the rafting facilities by the removal of snags and rocks, **87**, 1902.

By Maj. Lockwood, 1889, for slack-water navigation from low water in the Ohio to Pikeville, on the Levisa Fork and to the mouth of Pond, on the Tug Fork, involving the construction of 18 locks and dams, at an estimated cost of $3,396,557, **89**, 1992.

By Lt. Col. Merrill, 1887, for improvement of the Levisa Fork of the Sandy River by removal of snags and bowlders, at an estimated cost of $5,750, **88**, 1797.

**Private (State) work.**

Work done by State of Kentucky, **81**, 1980.

**Projects.** (See *Estimates* and *Plans.*)

Temporary improvement of river, 1875, by removal of obstructions, **75**, 759; **76**, ii, 140, 144; **79**, 146, 1353.

Permanent improvement, 1879, by locks and dams, dams to be of timber and subsequently to be replaced by movable

## BIG SANDY RIVER, KY. AND W. VA.—Continued.

### Part A.—Big Sandy River, Ky., and W. Va.—Continued.

dams; first lock and dam to be built at Louisa, **79**, 145, 1355.

By Lt. Col. Merrill, 1878, for the improvement of the natural channel, to afford a better raft and push-boat navigation; estimated cost, $15,000, **80**, 1828.

In 1880 modified by the construction of a lock and dam at Louisa, Ky., at estimated cost of $60,000, **80**, 1828.

Increased by Capt. Cuyler, 1881, to $110,000, **81**, 1981. Increased by Capt. Post, 1883, to $213,237.39, **83**, 1566. (See *Operations, 1880–83.*)

In 1887 it was estimated that $62,645.31 would be required to complete the project, **87**, 1824.

In 1891 the Board of Engineers proposed the construction of a movable dam of needles, supported by trestles, Poire's system, on the Big Sandy River near Louisa, Ky., at an estimated cost of $93,029.25, **92**, 2102.

The project for the improvement of the Levisa Fork of the Big Sandy River consisted, 1891, of facilitating rafting and push-boat navigation by removal of rock, snags, stumps, and similar obstructions, at an annual estimated cost of $2,500, **91**, 2466.

The project for improvement of the Tug Fork of the Big Sandy River consisted, 1891, of clearing the channel of rocks, snags, and stumps, and excavating channels through the ripples and shoals, to facilitate log rafting in the upper portion of the stream, and to provide a low-water push-boat channel, at an annual estimated cost of $2,500, **91**, 2468.

The approved plan, 1893, contemplated the construction of a navigable pass 130 f. long and a weir 140 f. long separated from the pass by a pier, **93**, 2632.

In 1893 Maj. Lockwood estimated it would cost $70,151.58 to complete the needle dam near Louisa, Ky. The increase over the original estimate caused by conditions not in view when the project was made, **94**, 2000.

By Maj. Gregory, 1896, with the approval of a Board of Engineers, for the substitution of the size of iron then manufactured for the size originally adopted; and for a change in the form of the trestle of the navigable pass so that when lying down the trestles would rest within, and not upon, each other, **96**, 2301.

By Maj. Gregory, 1897, for the construction of a boom 800 f. long to be located above the lock, for the retention of drift brought down by rises, **97**, 2531.

In 1897 Maj. Gregory estimated that had the lock and dam been constructed under favorable conditions the cost would probably have been $198,152. The actual cost was $349,155.82, **97**, 2552, 2555, 2559.

By Maj. Bixby, 1898, for carrying slackwater from the Ohio River to Pikeville on Levisa Fork, and the mouth of Pond Creek on Tug Fork, by 21 locks and movable dams in addition to the one already built below Louisa; estimated cost of additional work, $4,725,000, **98**, 2163; **99**, 434; **1900**, 3401.

**Surveys.** (See *Plans.*)

From mouth, via Levisa Fork, to Piketon, 112½ miles; also of Tug Fork from Louisa to Warfield, **75**, 73, 756, 760; **76**, ii, 140.

Of localities improved, **81**, 1980.

Examination of the upper part of Levisa Fork of Big Sandy River, made, 1883, under direction of Maj. Cuyler (report unfavorable) **84**, 1755.

Examination of Levisa Fork ordered by act of Aug. 5, 1886, made under the direction of Capt. Post, **87**, 1902.

Examination, from Catlettsburg to Pikeville on Levisa Fork, and to the mouth of Pond Creek on Tug Fork, ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Lockwood, **89**, 1990.

Survey of the Levisa Fork of Sandy River, ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. Merrill, **88**, 1796.

Examination of Russel Fork, ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Lockwood (report unfavorable), **91**, 2476.

Examination of the Big Sandy at its junction with the Ohio, ordered by act of July 13, 1892, to ascertain if a bar existed in that locality, and if so whether it could be removed by a proper confinement of the channel of the Big Sandy, made, 1892, by Maj. Lockwood (report unfavorable), **93**, 2647.

Congress, 1898, by concurrent resolution, called for plans and estimates of cost for improving the river. Report made in 1898 by Maj. Bixby (see *Projects*), **98**, 2159.

Survey of Big Sandy River, W. Va. and Ky., including Levisa and Tug forks, ordered by act of Mar. 3, 1899; preliminary report submitted, 1900, by Capt. Hodges (see *Projects*), **1900**, 3401.

Levels, 1900, 3405.

MAPS. (Photographs, etc.), **97**, 2560; (photographs), **98**, 2144.

## BIG SANDY RIVER, KY. AND W. VA.—Continued.

### Part B.—Big Sandy River, Levisa Fork, Ky. (See *Part A.*)

**Appropriations.**[a]
1894, $2,500, **95**, 2504.
1896, 1,000, **96**, 2321.
1899, 1,000, **99**, 2511.
1900, 1,000, **1900**, 3360.

Total, 5,500

**Commerce.**

Description of, **93**, 2635; **94**, 2001.

Large quantities of coal shipped, **93**, 2635; **94**, 2001.

Improvements effected by the United States had increased, 1896, the commerce 100 per cent., to a value of $23,890,000, **96**, 2321.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 333; **94**, 305; **95**, 341; **96**, 298; **97**, 376; **98**, 371; **99**, 436; **1900**, 499, 503.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1893–95. Reports, **93**, 2635; **94**, 2001; **95**, 2503.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2320; **97**, 2529.

Maj. W. H. Bixby, 1898–99. Reports, **98**, 2155.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2511; **1900**, 3360, 3400.

ASSISTANT. B. F. Thomas. Reports, **93**, 2636; **94**, 2002; **95**, 2504; **96**, 2321; **97**, 2530; **98**, 2156; **99**, 2512; **1900**, 3361.

**Operations.**

**1892–93.** About 2,000 c. y. rock and about 500 snags and other obstructions removed, **93**, 2636.

**1893–94.** About 1,500 c. y. rock and about 300 snags and other obstructions removed, **94**, 2002.

**1894–95.** Over 6,000 c. y. rock and about 400 snags and other obstructions removed, **95**, 2504, 2505.

**1895–96.** Over 3,000 c. y. rock and about 200 snags and other obstructions removed, **96**, 2321, 2322.

**1896–97.** About 6,000 c. y. rock and about 300 snags and other obstructions removed, **97**, 2530.

**1899–1900.** 267 c. y. rock and 137 snags removed from river, **1900**, 3362.

**Physical characteristics.**

The Levisa is the western of the two forks of the Big Sandy River, uniting with it about Louisa. It possesses all the characteristics of mountain streams. **93**, 2635; **98**, 2156.

At or near the mouth of Georges Creek, 15 miles above Louisa, the river had deepened and widened for some years prior to 1896. At that time ground over which it used to flow was being cultivated. **96**, 2321.

**Projects.**

By Maj. Bixby, 1898, for extending slack water up the Levisa Fork to Pikeville as part of the improvement of the Big Sandy River, **1900**, 499.

### Part C.—Big Sandy River, Tug Fork, Ky. (See *Part A.*)

**Appropriations.**[a]
1894 $2,500, **95**, 2506.
1896 2,000, **96**, 2324.
1899 1,500, **99**, 2509.

Total, 6,000.

**Commerce.**

Description of, **96**, 2323.

Improvements by the U. S. had, 1896, increased the commerce 100 per cent, to a total value of $8,472,000, **96**, 2323.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 333; **94**, 306; **95**, 341; **96**, 298; **97**, 375; **98**, 371; **99**, 436; **1900**, 498, 503.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1893–95. Reports, **93**, 2637; **94**, 2002; **95**, 2505.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2323; **97**, 2528.

Maj. W. H. Bixby, 1898–99. Report, **98**, 2152.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2508; **1900**, 3357, 3400.

ASSISTANT. B. F. Thomas. Reports, **93**, 2638; **94**, 2004; **95**, 2506; **96**, 2324; **97**, 2528; **98**, 2153; **99**, 2509; **1900**, 3358.

**Legal proceedings.**

The Norfolk and Western R. R. et al. in 1891 was perpetually enjoined from causing obstructions in the river by dumping, etc., **93**, 2637, **94**, 2003.

**Obstructions.**

Complaints made that the Norfolk and Western R. R. had not removed the obstructions from the river, due to the construction of its road along the right bank, as ordered by the injunction of 1891, **93**, 2637; **94**, 2003.

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[a] 1880–92, $23,250. (See *Part A.*)

## BIG SANDY RIVER, KY. AND W. VA.—Continued.

### Part C.—Big Sandy River, Tug Fork, Ky.—Continued.

**Operations.**

**1892-93.** Over 4,000 c. y. rock and over 200 snags and other obstructions removed, **93**, 2638.

**1893-94.** Over 2,000 c. y. rock and about 300 snags and other obstructions removed, **94**, 2004.

**1894-95.** Over 6,000 c. y. rock and about 400 snags and other obstructions removed, **95**, 2508.

**1895-96.** Over 3,000 c. y. rock and about 200 snags, etc., removed, **96**, 2324.

**1896-97.** Over 5,000 c. y. rock and about 100 snags, etc., removed, **97**, 2529.

**1897-98.** Walls at Yoces sluice repaired and rebuilt; about 1,500 c. y. rock and over 100 snags, etc., removed, **98**, 2152.

**1899-1900.** About 1,800 c. y. rock and 145 snags removed from river, **1900**, 3359.

**Physical characteristics.**

The Tug Fork is the eastern of the two forks which unite at the town of Louisa to form the Big Sandy River. It has all the characteristics of a mountain stream. **93**, 2637; **96**, 2323.

**Projects.**

By Maj. Bixby, 1898, for extending slack water up the Tug Fork to the mouth of Pond Creek, as a part of the improvement of Big Sandy River, **99**, 436.

## BIG SANDY RIVER, KY. AND W. VA. (Lock and dam, operating and care of.)

**Appropriations.**[a]

| | |
|---|---|
| 1898, | $1,936.54 |
| 1899, | 3,132.80 |
| 1900, | 3,615.94 |
| Total, | 8,685.28 |

**Engineers.**

Chief of Engineers. Reports, **98**, 370; **99**, 435; **1900**, 498.

Engineers in Charge:

Maj. W. H. Bixby, 1898-99. Report, **98**, 2150.

Capt. H. F. Hodges, 1899-. Reports, **99**, 2505; **1900**, 3353.

Assistant. B. F. Thomas. Report, **98**, 2152, 2164; **99**, 2507; **1900**, 3356.

**Operations.**

For miscellaneous work done each year see references to *Engineers in Charge.*

**Projects.**

Operating and care of lock and dam placed under indefinite appropriation July 1, 1897, **98**, 2150.

## BIG STONE LAKE, MINN. (See *Mississippi River; Red River of the North.*)

## BIG SUNFLOWER RIVER, MISS. (See *Bogue Phalia, Miss.*)

**Appropriations.**

| | | |
|---|---|---|
| 1879, | $20,000, | **79**, 116. |
| 1880, | 8,000, | **80**, 1318. |
| 1881, | 4,000, | **81**, 1411. |
| 1882, | 5,000, | **82**, 1549. |
| 1884, | 5,000, | **84**, 1335. |
| 1886, | 5,000, | **86**, 1359. |
| 1888, | 5,000, | **88**, 1367. |
| 1890, | 5,000, | **90**, 1903. |
| 1892, | 5,000, | **92**, 1656. |
| 1894, | 5,000, | **95**, 1951. |
| 1896, | 5,000, | **96**, 1632. |
| 1899, | 5,000, | **99**, 2024. |
| Total, | 77,000 | |

**Commerce.**

Advantages resulting from improvement, **85**, 1511.

Reduction in freight rates consequent upon improvement, **89**, 1617; **91**, 245.

Description of; not unimportant, **93**, 1639, 1900.

The average commerce, 1900, for the last 11 years 32,258 tons annually, valued at $970,000, **1900**, 412.

**Engineers.**

Chief of Engineers. Reports, **78**, 88; **79**, 116, 117; **80**, 155; **81**, 208; **82**, 206; **83**, 214; **84**, 224; **85**, 238; **86**, 234; **87**, 200; **88**, 183; **89**, 214; **90**, 193; **91**, 245; **92**, 238; **93**, 268; **94**, 248; **95**, 277, 280; **96**, 242, 243; **97**, 308; **98**, 300; **99**, 359; **1900**, 411.

Engineers in Charge:

Capt. W. H. H. Benyaurd, 1878-82, **78**, 88; **79**, 112, 117. Reports, **79**, 970, 983; (Maj.), **80**, 1316; **81**, 1408; **82**, 1548.

Maj. A. M. Miller, 1882-85. Reports, **83**, 1145; **84**, 1334; **85**, 1511.

Capt. E. Bergland, 1885-86. Report, **86**, 1359.

Capt. J. H. Willard, 1886-99. Reports, **87**, 1477; **88**, 1365; **89**, 1617; **90**, 1901; **91**, 2007; **92**, 1654; **93**, 2047; **94**, 1513;

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[a] Expenditures under the permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## BIG SUNFLOWER RIVER, MISS.—Continued.

**95**, 1949; (Maj.), **96**, 1630, 1638; **97**, 1935; **98**, 1639; **99**, 2022.

Maj. T. L. Casey, 1900. Report, **1900**, 2537.

Assistants:

J. M. Searles, **79**, 982. Report, **80**, 1316.

J. J. Barry. Reports, **81**, 1409; **82**, 1549; **83**, 1146.

C. W. Phifer. Report, **85**, 1512.

H. M. Marshall. Report, **96**, 1644.

**Obstructions.** (See *Physical characteristics below.*)

**Operations.**

**1879-80.** 10 wing dams built by hired labor at Olephant Bar; removal of snags and logs, **80**, 155, 1316.

**1880-81.** 472 snags and logs removed and 7,000 trees cut down; wing-dams built at Callao and Vick's Landing, **81**, 1408.

**1881-82.** 20,245 trees cut down, 186 logs removed, 775 l. f. wing dams built at Callao, Shell Ridge, and Vick's Landing, **82**, 1548.

**1882-83.** 20,433 trees cut down, 3,109 logs and snags and 600 brush piles removed, **83**, 1145,

**1884-85.** 2,524 l. f. wing dams built at Olephant, Callao, Woodburn, Johnsonville, and Hollywood; 400 logs and snags removed, **85**, 1511, 1513.

**1886-87.** 46 snags, stumps, and logs removed, and 1,115 l. f. of wing dams built, **87**, 1478.

**1887-88.** 117 snags and 164 c. y. earth removed from the channel; 5,151 l. f. wing dams built; 319 trees and 8,260 s. y. willows cleared from the banks, **88**, 1366.

**1888-89.** 140 logs and snags removed from the channel, and 619 trees cleared from the banks, **89**, 1617.

**1889-90.** 813 l. f. of wing dams built; 15 snags removed from the channel and 5 trees from the banks; 375 l. f. of brush wing dams built, **90**, 1902.

**1890-91.** 645 snags and 2 wrecks removed from the channel, and 320 trees cleared from the banks; 375 l. f. of brush wing dams built, **91**, 2008.

**1891-92.** 50 snags and logs removed from the channel, and 23 trees cut from the banks, **92**, 1655.

**1892-93.** Part of wreck removed; 1,065 s. y. brush and willows cut; and about 17,800 snags and other obstructions removed, **93**, 2050.

**1895-96.** One old dam repaired; 23 wing dams, amounting to 1,810 l. f., built; 5,463 s. y. brush and willows cut; and nearly 25,000 snags, etc., removed, **96**, 1632.

**1897-98.** 32 wing dams, amounting to 2,817 l. f., built; 3,305 s. y. brush and willows cut; and 61,600 snags, etc., removed, **98**, 1640.

**1898-99.** At Hollywood Bar a wing dam was built to cause scour; an old dam repaired, **99**, 2022.

**1899-1900.** 20 wing dams built and 14 old dams repaired; 10,069 snags and other obstructions and 35,700 s. y. willows and brush removed from channel, **1900**, 2538, 2539.

**Physical characteristics.**

Described, **79**, 983; **85**, 1511; **93**, 2049; **96**, 1631, 1639; **98**, 1639.

Obstructions, **79**, 983, 984.

Great beneficial changes since 1878. Gain in depth. **96**, 1641.

Water escaping through crevasses along the Mississippi front during a flood said to have brought in large quantities of drift, etc., **97**, 1935.

**Projects.**

By Maj. Benyaurd, 1879, for improving the river to a depth of from 3 to 3½ f. by removal of obstructions from the lower part of the river, and the improvement of Olephant Bar and Muscle Shoals by wing dams; estimated cost $66,000, **79**, 116, 970; **86**, 234; **88**, 1365; modified, 1899, by Maj. Willard to permit expending $20,000 in one or two seasons of low water, and $3,000 annually for maintenance, **99**, 2023.

**Surveys.**

Examination ordered and in progress, **78**, 88.

Examination completed by J. M. Searles, **79**, 117, 982.

Olephant Bar and Muscle Shoal, **80**, 1316.

Line of precise levels run from Friars Point, on the Mississippi, to Clarksdale, to check base lines of probable survey for locks and dams, **95**, 1951.

Examination with a view to improving river to Clarksdale with locks and dams ordered by act of August 17, 1894, made, 1896, under direction of Maj. Willard (report favorable to limited improvement), **96**, 1638.

## BILOXI BAY AND HARBOR, MISS. (See *Back Bay.*)

**Appropriations.**

1882, $5,000, **83**, 1029.
1886, 12,500, **86**, 1206.
1888, 18,500, **88**, 1215.
1890, 9,000, **90**, 1711.

Total, 45,000

**Commerce.**

Benefit to commerce from improvement, **88**, 1215; **89**, 1448.

**Contracts.**

**1887.** G. C. Fobes & Co., dredging, 17 cents per c. y., **88**, 1215.

**1890.** Alabama Dredging and Jetty Co., dredging, 14⅜ cents per c. y., **90**, 1710.

**1892.** Alabama Dredging and Jetty Co., dredging, 18 cents per c. y., s. m., **93**, 1774.

**Engineers.**

Chief of Engineers. Reports, **81**, 189; **82**, 186; **83**, 197; **84**, 206; **85**, 212; **86**, 209; **87**, 176; **88**, 164; **89**, 191; **90**, 172; **91**, 219; **92**, 212, **93**, 234; **94**, 216; **95**, 241.

Engineer in Charge:

Capt. A. N. Damrell, 1882–95. Reports, **82**, 1322; **83**, 1029; **84**, 1217; **85**, 1360; **86**, 1205; **87**, 1333; **88**, 1214; **89**, 1447; **90**, 1709; **91**, 1793; **92**, 1458; **93**, 1772; **94**, 1325; **95**, 1705.

Assistant. T. L. Harrison. Report, **82**, 1323.

**Operations.**

**1886–87.** Location of channel made, **87**, 1333.

**1887–88.** 84,686 c. y. dredged, **88**, 1215.

**1890–91.** 97,092 c. y. dredged, **91**, 1794.

**1892–93.** 12,678 c. y. dredged and project completed, **93**, 1774.

**Projects.**

By Maj. Damrell, 1881, for dredging the channel between the wharves at Biloxi and deep water in Mississippi Sound to 8 f.; estimated cost, $35,000, **82**, 1322, 1323. The work not considered susceptible of permanent improvement, **84**, 1217. Estimated cost increased in 1885 to $55,000, **85**, 1361; **91**, 1793.

Project completed, **92**, 1460.

**Surveys.**

Ordered by act of Mar. 3, 1881, made under the direction of Maj. Damrell, 1881, **82**, 1322.

Examination made, 1893, by Maj. Damrell showed a minimum width of 160 f. and a depth of 9 f., **94**, 1325.

## BIRMINGHAM, ALA., CANAL FROM, TO THE WARRIOR RIVER.

**Engineers:**

Chief of Engineers. Report, **97**, 275.

Engineer in Charge. Maj. W. T. Rossell, 1897. Report, **97**, 1704.

## BISCAYNE BAY, FLA. (See *Palmbeach.*)

**Appropriations.**

1896, [a] $1,500, act Feb. 26.

**Commerce.**

Description of, **95**, 1569; **1900**, 1990, 1994.

In 1895 the apparent value of the commerce warranted a survey, **95**, 1570. In 1897 the commercial statistics were not sufficiently definite to determine what benefit would be derived by an improvement of the bay by the Government, **97**, 1572.

**Engineers.**

Chief of Engineers. Report, **95**, 221; **97**, 252; **1900**, 316.

Board of Engineers. Convened at St. Augustine, Fla., Mar. 29, 1899, by S. O. No. 14, dated Mar. 16, 1899, to examine and report upon the respective routes from Miami to the sea, by Norris Cut, Bear Cut, and Cape Florida Entrance, respectively, with reference to the most feasible route and the cost of providing a channel 18 f. in depth and of suitable width, with a view to ascertain the desirability of improving the same. Report, **1900**, 1987.

(Maj. W. T. Rossell, Capts. C. E. Gillette (replacing Lt. Col. W. H. H. Benyaurd, deceased), and C. H. McKinstry.)

Engineers in Charge:

Maj. T. H. Handbury, 1895. Report, **95**, 1567.

Lt. Col. W. H. H. Benyaurd, 1897. Report, **97**, 1588.

Capt. C. H. McKinstry, 1899. Report, **1900**, 1986.

Assistants:

J. W. Sackett. Report, **97**, 1592.

O. N. Bie. Report, **97**, 1594.

J. H. Bacon. Reports, **1900**, 2000, 2002.

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[a] Survey of Biscayne Bay and Palmbeach.

## BISCAYNE BAY, FLA.—Continued.

**Physical characteristics.**

Description of, **95**, 1567; **97**, 1589, 1590, 1591; **1900**, 2002.

Bay located on the east coast of Florida and near its southern extremity, **95**, 1567.

**Private work.**

The Florida East Coast Railway Co. to some extent improved the channel of a tributary of the bay, and out into the bay for about 2 miles, **97**, 1589.

**Projects.**

In 1897 Lt. Col. Benyaurd estimated that it would cost from $239,000 to $845,000 to make an improvement according to plans submitted, **97**, 1588.

Board of Engineers estimated, 1900, it would cost $1,493,743 for an 18-f. channel, bottom widths 150, 200, and 300 f., and having a basin 1,200 f. long by 400 f. wide, via Norris Cut, **1900**, 1987.

**Surveys.**

Examination of the entrance ordered by act of Aug. 17, 1894, made by Maj. Handbury, 1895 (report favorable), **95**, 1567.

Survey ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd, 1897 (see *Projects*), **97**, 1589.

Examination and survey with view to constructing a channel 18 f. deep, from Miami to the sea, by way of Norris Cut, Bears Cut, or Cape Florida Entrance, ordered by act of Mar. 3, 1899, made, 1900, under direction of a Board of Engineers (report unfavorable) (see *Projects*), **1900**, 1987.

## BISMARCK, N. DAK. (See *Missouri River.*)

## BISSELLS COVE, R. I.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 99.

ENGINEER IN CHARGE:

Maj. J. W. Barlow, 1884. Report, **84**, 663.

**Plans.**

The improvement desired was a channel 6 f. deep and 60 f. wide between Narragansett Bay and the wharves, 1,200 yards. Doubtful whether the work constituted a public necessity. **84**, 663.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Maj. Barlow (see *Plans*), **84**, 663.

## BISTENEAU. (See *Lake Bisteneau.*)

## BLACK AND DUWAMISH RIVERS, WASH. (See *Puget Sound.*)

**Commerce.** (See *Physical Characteristics.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 342; **91**, 409; **98**, 525.

ENGINEERS IN CHARGE.

Capt. C. F. Powell, 1884. Report, **84**, 2296.

Capt. T. W. Symons, 1891. Report, **91**, 3257.

Capt. H. Taylor, 1896–98. Report, **98**, 3103.

ASSISTANTS.

A. J. McMillan. Report, **91**, 3259.

R. H. Ober. Report, **98**, 3106.

**Physical characteristics.**

Description of, **84**, 2296; **91**, 3258; **98**, 3104.

The city of Seattle is situated about 2 miles from the mouth of the river, which is about 16 miles long and is formed by the junction of the Black and White rivers. In 1898 there was no navigation on any part. **98**, 3104.

**Surveys.**

Examination ordered by act of Aug. 2, 1882; made under the direction of Capt. Powell (report favorable, but work not a public necessity), **84**, 2296.

Examination of Black and Dwamish rivers ordered by act of Sept. 19, 1890; made, 1890, under direction of Capt. Symons (report unfavorable), **91**, 3258.

Survey of the river and its tributaries ordered by act of June 3, 1896, made 1898 by Capt. Taylor (report unfavorable), **98**, 3103.

## BLACK AND ST. CLAIR RIVERS, MICH. (See *St. Clair River.*)

## BLACK AND TERREBONNE BAYOUS (between Southdown Plantation and Houma, La.). (See *Black Bayou, La.*)

**Commerce.**

Unimportant, **93**, 1846.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 251.

ENGINEER IN CHARGE. Maj. J. B. Quinn, 1893. Report, **93**, 1845.

ASSISTANT. P. H. Thomson. Report **93**, 1846.

## BLACK AND TERREBONNE BAYOUS (between Southdown Plantation and Houma, La.)—Continued.

**Physical characteristics.**

Description of. District examined, 1892, possessing value only as a part of, and as a connecting link in the system of tide water canals from the Mississippi to Berwicks Bay and beyond. **93**, 1846.

Comparative distances from New Orleans to Berwicks Bay, **93**, 1847.

**Surveys.**

Examination with a view to opening a shorter and safer inland waterway from the Mississippi Valley, via Berwicks Bay, to Texas and Mexico, ordered by act of July 13, 1892, made, 1892, under direction of Maj. Quinn (report unfavorable), **93**, 1845.

## BLACK BAYOU, LA.[a] (See *Black and Terrebonne Bayous; Red River, Ark., La., and Tex.*)

**Appropriations.**

1881, $10,000, **81**, 1289.
1882, 10,000, **82**, 1380.
1884, 5,000, **84**, 1277.

Total, 25,000

**Commerce.**

Local, **85**, 1402; **86**, 1262; **87**, 1370.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 195, 197; **82**, 191; **83**, 209; **84**, 213; **85**, 219; **86**, 217; **87**, 183; **91**, 229, 230.

ENGINEERS IN CHARGE.

Maj. C. W. Howell, 1880–81. Report, **81**, 1288.

Maj. A. Stickney, 1881–84. Reports, **82**, 1379; **83**, 1120; **84**, 1276.

Capt. T. Turtle, 1884–85. Report, **85**, 215.

Maj. W. H. Heuer, 1885–87. Reports, **85**, 1400; **86**, 1261; **87**, 1368.

Capt. W. L. Fisk, 1888–91. Reports, **88**, 1251; **91**, 1846, 1850.

ASSISTANT: H. S. Douglass. Report, **81**, 1289.

**Operations.** (All operations by hired labor.)

**1881–82.** Dredge hull built from joint appropriations of Black and Terrebonne bayous, **82**, 1380; **83**, 209.

**1882–83.** 21,000 c. y. removed by U. S. dredge; 161 logs and 2 wrecks removed, **83**, 1120.

**1883–84.** 158,403 c. y. material, 755 logs, and 3 wrecks removed by U. S. dredge, **84**, 1276.

**1884–85.** Dredging by U. S. dredge, **85**, 1401.

**1885–86.** Repair of U. S. dredge, **86**, 1263.

**Physical characteristics.**

Description of, **85**, 1401; **88**, 1251.

**Projects.**

By Maj. Howell, 1881, for cleaning the bayou of obstructions and dredging a channel 59 f. wide and 6 f. deep from Bayou Cane to Tigerville, 24 miles, estimated cost, $47,520, **81**, 1288, 1292.

Increased in 1885 to $81,000, **85**, 1402; **87**, 1369.

In 1887 Maj. Heuer considered the improvement of the bayou local in its benefits, **87**, 1370.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 146; made under direction of Maj. Howell, 1881, **81**, 1288.

Examination of Black Bayou to connect with Terrebonne Bayou ordered by act of Sept. 19, 1890; made, 1890, under direction of Capt. Fisk (report unfavorable), **91**, 1846.

Examination of Black Bayou for connection between Calcasieu Lake and Sabine Lake ordered by act of Sept. 19, 1890; made, 1890, under direction of Capt. Fisk (report unfavorable), **91**, 1851.

## BLACK CREEK SHOAL, LAKE ONTARIO.

**Engineers.**

CHIEF OF ENGINEERS. Report, **92**, 420.

ENGINEER IN CHARGE. Capt. D. C. Kingman, 1892. Report, **92**, 3428.

ASSISTANT. W. P. Judson. Report, **92**, 3429.

**Surveys.**

Survey of Black Creek Shoal, made 1891, under direction of Capt. Kingman, **92**, 3428.

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[a] This is distinct from Black River, La., which, being formed by junction of Ouachita, Tensas, and Little rivers at Trinity, La., enters Red River near the latter's mouth.

## BLACK LAKE, LA. (See *Black Bayou; Red River, Ark.*)

## BLACK LAKE (HOLLAND) HARBOR, MICH.[a] (See *Holland Harbor, Mich.*)

## BLACK RIVER. (See *Little River, La.; White, Black, etc.*)

## BLACK RIVER, ARK. AND MO.[b]

## BLACK RIVER, LA. (See *Ouachita River.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 227.

ENGINEER IN CHARGE. Capt. A. M. Miller, 1884. Report, **84**, 1363.

**Surveys.**

Examination for cut-offs ordered by act of August 2, 1882, made, 1882, under direction of Capt. Miller (report unfavorable), **84**, 1363.

## BLACK RIVER, MICH. (See *St. Clair River.*)

**Appropriations.**

1888, $10,000, **89**, 2260.
1890, 10,000, **90**, 2736.
1892, 10,000, **92**, 2472.
1894, 4,000, **95**, 2837.
1896, 4,000, **97**, 3022.
1899, 4,000, **99**, 2993.

Total, 42,000

**Commerce.**

Benefit of improvement to general lake commerce, **89**, 2260.

**Contracts.**

**1889.** W. Richardson, dredging, 20 cents per c. y., **89**, 2260.

**1891.** Bay City Dredging Co., dredging, 16 cents per c. y., **91**, 2782.

**1892.** L. E. Allen, dredging, 41,692 c. y., at 18⅞ cents per c. y., **93**, 2942.

**1897.** E. Hall, dredging, 10 cents per c. y., s. m., **97**, 3022.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 294; **88**, 264; **89**, 313; **90**, 283; **91**, 355; **92**, 339; **93**, 386; **94**, 358; **95**, 393; **96**, 348; **97**, 446; **98**, 433; **99**, 515; **1900**, 579.

ENGINEERS IN CHARGE:

Lt. Col. O. M. Poe, 1886–92. Report, **87**, 2279; (Col.), **89**, 2259; **90**, 2735; **91**, 2782; **92**, 2471.

Maj. W. Ludlow, 1893. Report, **93**, 2940.

Lt. Col. G. J. Lydecker, 1894–. Reports, **94**, 2253; **95**, 2836; **96**, 2735; **97**, 3021; **98**, 2585; **99**, 2992; **1900**, 3986.

**Operations.**

**1888–89.** 20,800 c. y. dredged, **89**, 2260.

**1889–90.** 26,000 c. y. dredged, **90**, 2736.

**1890–91.** 17,504 c. y. dredged, **91**, 2783.

**1891–92.** 40,011 c. y. dredged, **92**, 2471.

**1892–93.** 41,692 c. y. dredged, and project completed, **93**, 2941.

**1896–97.** 729 c. y. dredged, **97**, 3021.

**1897–98.** 45,729 c. y. dredged, **98**, 2585.

**Physical characteristics.**

Description of, **90**, 2735.

Shoaling, **99**, 2992.

**Projects.**

By Lt. Col. Poe, 1887, removal of the shoal at its mouth to a uniform depth of 17 f.; estimated cost, $69,300, **87**, 2280.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. Poe, **87**, 2279.

Minor surveys, **99**, 2992; **1900**, 3986.

## BLACK RIVER, MICH. (LAKE SUPERIOR).

**Commerce.**

None of importance, **89**, 2026.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 274.

ENGINEER IN CHARGE. Maj. J. B. Quinn, 1889. Report, **89**, 2026.

**Physical characteristics.**

Width of mouth about 15 f., at no place deeper than 12 f., and at some places only 18 in. deep. The river bottom apparently of sandstone, **89**, 2026.

**Surveys.**

Examination of river mouth made, 1888, by Maj. Quinn (report unfavorable), **89**, 2026.

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[a] Surveys.—Reports, Oct. 24, 1849, estimate, $116,018.08. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Survey.—Report, Aug. 1, 1837. (H. Doc. No. 482, 55th Cong., 2d sess.)

## BLACK RIVER, N. C.

**Appropriations.**

1886, $3,000, **87**, 1004.
1892, 10,000, **92**, 1157.
1894, 2,000, **95**, 1332.
1896, 1,000, **96**, 1126.
1899, 2,000, **99**, 1503.

Total, 18,000

**Commerce.**

Important, **85**, 1147; **87**, 1043.

Value of improvement to river navigation, **89**, 1083.

An active trade in naval stores, lumber, etc., and logs are rafted down in considerable quantities; a railroad parallels the stream, but freight rates are lower by water, **93**, 1408.

Description of, **1900**, 1813.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 177; **85**, 177; **87**, 130; **88**, 123; **89**, 143; **90**, 128; **91**, 164; **92**, 164; **93**, 177; **94**, 163; **95**, 186; **96**, 167; **97**, 207; **98**, 208; **99**, 240; **1900**, 273.

ENGINEERS IN CHARGE:

Capt. J. Mercur. Report, **84**, 1061.

Capt. W. H. Bixby, 1884–92. Reports, **85**, 1145, 1148; **87**, 1042; **88**, 889; **89**, 1081; **90**, 1145; **91**, 1387.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1154; **93**, 1407; **94**, 1042; **95**, 1331.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1125.

Capt. W. E. Craighill, 1897. Reports, **97**, 1402; **98**, 1251.

Capt. E. W. Van C. Lucas, 1899–. Reports, **99**, 1502; **1900**, 1813.

ASSISTANTS:

G. H. Elliott. Report, **84**, 1061.

C. Humphreys. Reports, **85**, 1157; **88**, 891; **90**, 1147; **91**, 1388.

E. D. Thompson. Report, **93**, 1409.

C. Schuster. Reports, **96**, 1126; **97**, 1403.

**Legislation.**

Act of the State of North Carolina incorporating the Black River Navigation Co., **85**, 1153.

Repeal of State act, **87**, 1043.

**Obstructions.**

List of bridges obstructing the stream, **93**, 1409. The county bridge at Point Caswell rebuilt in 1896 with a clear width of draw of 27½ f., **96**, 1125.

**Operations.**

**1887–88.** 438 logs and stumps removed from river channel, and 472 trees and 98 cords of brush removed from the banks, **88**, 890.

**1889–90.** 30 piles and snags removed from the channel, and 155 trees and 573 cords of brush removed from the banks, **90**, 1146.

**1892–93.** Over 3,000 logs and other obstructions removed from channel and banks, **93**, 1409.

**1893–94.** About 1,200 logs and other obstructions removed from the channel and banks, **94**, 1043.

**1894–95.** About 800 logs and other obstructions removed from the channel and banks, **95**, 1332.

**1895–96.** About 1,800 logs and other obstructions removed from the channel and banks, **96**, 1125.

**1896–97.** About 600 logs and other obstructions removed from the channel and banks, **97**, 1404.

**1898–99.** 48 snags and other obstructions removed from channel, **99**, 1502.

**1899–1900.** 577 snags, 35 trees, 206 stumps removed from channel, and 409 trees from the banks, **1900**, 1813.

**Physical characteristics.**

Description of, **84**, 1061; **85**, 1146, 1149, 1151.

Original condition of the river, **88**, 889.

Water-gauge record for 1891, **91**, 1388.

**Private (corporate) work.** (See *Projects, second par.*)

**Projects.**

By Capt. Bixby, 1884, to secure a thoroughly cleared natural channel over the 70 miles of river between its mouth and Lisbon, and afterwards a 4-f. low-water channel below Point Caswell. Estimated cost, $33,500. **85**, 1148; **87**, 1043.

A part of the river controlled by a corporate company, whose rights should be ceded to the United States before expenditures are made, **85**, 1149; **87**, 1043.

By Maj. Stanton, 1895, for modification of project of 1885 to exclude the 7 miles of river above Clear Run Bridge from improvement, and to clear obstructions from the river from the mouth to Clear Run Bridge at a cost not to exceed a total sum of $13,000, any balance remaining to be used for keeping the river clear of obstructions, **93**, 1407.

In 1896 Lt. Col. Heap estimated the cost of annual maintenance at $2,000 annually, **96**, 1125.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Mercur (report unfavorable), **84**, 1061.

Survey made, 1884, under the direction of Capt. Bixby, **85**, 1148.

## BLACK RIVER, N. Y.[a]

**Appropriations.**

1836, $5,000, 73, 378.
1837, 10,000. Act of Mar. 3.
1838, 22,401. Act of July 7.
1844, 3,000, 73, 378 (allotted).
1873, 5,000, 73, 48.

Total, 45,401.

**Commerce.**

Unimportance of, 73, 380; 97, 3308.

**Contracts.**

C. Daly, dredging, 35 cents per c. y., 73, 379.

**Engineers.**

CHIEF OF ENGINEERS. Reports, 73, 48; 74, 55; 89, 2429; 97, 482.

ENGINEERS IN CHARGE:

Lt. J. E. Johnston, 1839, 73, 378.

Capt. Canfield, 1842, 73, 378.

Col. J. J. Abert, 1844, 73, 378.

Maj. J. M. Wilson, 1873–74. Reports, 73, 378; 74, 268.

Capt. C. F. Palfrey, 1888–89. Report, 89, 2429.

Maj. W. S. Stanton, 1896–97. Report, 97, 3306.

ASSISTANTS:

W. P. Judson. Reports, 73, 380; 97, 3309.

M. T. Stockton, 73, 378.

**Operations.**

**1837–38.** North pier extended 2,719 l. f.; south, 2,408 l. f., 73, 378.

**1839.** North pier extended 1,260 l. f.; south, 300 l. f., 73, 378.

**1844.** South pier extended 390 l. f., 73, 378.

**1873–74.** 11,500 c. y. dredged, 74, 55, 268.

**Physical characteristics.**

Description of, 73, 380; 74, 268; 89, 2429; 97, 3307.

The river a succession of rapids, 73, 379.

The river flows into Black River Bay, an arm of Lake Ontario, joining the lake 15 miles from the head of the St. Lawrence River, 97, 3307. The sandy soil which the river carries down with its swift currents causes shoals in the bay which must ever be contended against in the maintenance of a navigable channel, 97, 3308.

**Projects.**

**1837–38.** For prolonging the banks of the river by piers to deep water in the bay, 73, 378.

**1873.** By Maj. Wilson, for extension of the south pier 6,800 f., and of the north pier 4,200 f.; also repairs and dredging; estimated cost, $214,000, 73, 379; 74, 268.

**Surveys.**

By M. T. Stockton, 1836, 73, 378.

By W. P. Judson, 1873. Report, 73, 380.

Resurvey, 74, 268.

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Palfrey (report unfavorable), 89, 2429.

Examination of the river to Dexter ordered by act of June 3, 1896, made in that year under the direction of Maj. Stanton (report unfavorable), 97, 3306.

## BLACK RIVER, PORT HURON, MICH.

**Appropriations.**

1890, $25,000, 91, 2781.
1892, 10,000, 92, 2470.
1894, 4,000, 95, 2835.
1896, 4,000, 96, 2734.
1899, 4,000, 99, 2994.

Total, 47,000

**Contracts.**

**1891.** C. E. Mitchell, dredging, 11⅞ cents per c. y., 91, 2781.

**1893.** L. P. & J. A. Smith, dredging, 18 cents per c. y., 93, 2940.

**1897.** E. Hall, dredging, 8 cents per c. y., s. m., 97, 3023.

**1900.** E. Hall, dredging, 14 cents per c. y., 1900, 3989.

**Engineers.**

CHIEF OF ENGINEERS. Reports, 89, 320; 91, 354; 92, 339; 93, 385; 94, 358; 95, 392; 96, 347; 97, 446; 98, 433; 99, 515; 1900, 580.

ENGINEERS IN CHARGE:

Col. O. M. Poe, 1888–92. Reports, 89, 2291; 91, 2780; 92, 2469.

Maj. W. Ludlow, 1893. Report, 93, 385.

Lt. Col. G. J. Lydecker, 1894. Reports, 94, 2251; 95, 2834; 96, 2733; 97, 3028; 98, 2586; 99, 2993; 1900, 3987.

**Operations.**

**1890–91.** 18,225 c. y. dredged, 91, 2781.

**1891–92.** 73,048 c. y. dredged, 92, 2470.

**1892–93.** 93,716 c. y. dredged, 93, 2938.

**1893–94.** 46,630 c. y. dredged, 94, 2251.

**1896–97.** 16,844 c. y. dredged, 97, 3022.

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[a] Examination—Report (favorable), July 15, 1829. Survey—Report, 1836; estimate, $26,998.77 (H. Doc. No. 482, 55th Cong., 2d sess.)

## BLACK RIVER, PORT HURON, MICH.—Continued.

**1897–98.** 53,205 c. y. dredged, **98**, 2587.

**Physical characteristics.**

Description of, **89**, 2291.

Channels dredged in upper part of the improvement probably not permanent, **99**, 2994.

**Projects.**

By Col. Poe, 1889, for improvement of Black River by excavation of a channel 15 f. deep, and of a width varying from 160 to 87 f. from the mouth through the city of Port Huron to the Grand Trunk R. R. bridge, 8,200 f.; estimated cost, $55,110, **89**, 2292, 2293. Depth increased in 1891 to 16 f., increasing the estimated cost to $75,000, **91**, 2781; **92**, 2469.

**Surveys.**

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Col. Poe, **89**, 2292.

Minor surveys, **99**, 2993; **1900**, 3988.

## BLACK RIVER, S. C.

**Commerce.**

No navigation, **81**, 1041.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 168; **91**, 170.

ENGINEERS IN CHARGE:

Capt. C. B. Phillips. Report, **81**, 1040.
Capt. W. H. Bixby. Report, **91**, 1435.

ASSISTANTS:

C. W. Forster. Report, **81**, 1041.
Lt. M. M. Patrick. Report, **91**, 1437.

**Physical characteristics.**

Description of, **81**, 1041; **91**, 1436.

**Plans.**

By Capt. Bixby, 1890, for removing snags and obstructions from the mouth upward 118 miles to the railroad bridge at Kingstree; estimated cost, $25,000, **91**, 1436.

**Surveys.**

From Kingston to its mouth, ordered by act of June 14, 1880, **80**, 125, made under direction of Capt. Phillips (report unfavorable), **81**, 1040.

Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Bixby, **91**, 1435.

## BLACK RIVER (LORAINE) HARBOR, OHIO.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1828, | $7,500.00, | **66**, iii, 33. |
| 1830, | 8,559.77, | **66**, iii, 33. |
| 1831, | 9,275.00, | **66**, iii, 33. |
| 1832, | 8,000.00, | **66**, iii, 33. |
| 1833, | 2,400.00, | **66**, iii, 33. |
| 1834, | 5,000.00, | **66**, iii, 33. |
| 1835, | 4,400.00, | **66**, iii, 33. |
| 1836, | 6,660.00, | **66**, iii, 33. |
| 1837, | 6,410.00, | **66**, iii, 33. |
| 1838, | 5,000.00, | **66**, iii, 33. |
| 1852, | 5,000.00, | **66**, iii, 33. |
| 1864, | 20,000.00, | **66**, iii, 33. |
| 1866, | 10,000.00, | **66**, iii, 33. |
| 1872, | 20,000.00, | **72**, 229. |
| 1873, | 20,000.00, | **73**, 122. |
| 1874, | 20,000.00, | **74**, 50. |
| 1875, | 10,000.00, | **75**, 151. |
| 1676, | 6,000.00, | **76**, 142. |
| 1878, | 1,000.00, | **78**, 129, 1259. |
| 1880, | 1,000.00, | **80**, 2132. |
| 1881, | 7,000.00, | **81**, 2307. |
| 1882, | 7,000.00, | **82**, 2397. |
| 1884, | 10,000.00, | **84**, 2096. |
| 1886, | 10,000.00, | **86**, 1862. |
| 1888, | 10,000.00, | **88**, 2000. |
| 1890, | 12,000.00, | **90**, 2772. |
| 1892, | 20,000.00, | **92**, 2502. |
| 1894, | 10,000.00, | **95**, 3098. |
| 1896, | 30,000.00, | **96**, 2938. |
| 1899, | 50,000.00, | **99**, 3055. |
| 1900, | 125,000.00, | **1900**, 4057. |

Total, 467,204.77

**Commerce.**

The general commerce of the lake benefited by this improvement, **66**, 24. Requirements of, discussed, **72**, 239; **75**, 301.

Increasing, **96**, 2938; **97**, 3073; rapidly, **98**, 2660, 2719, 2721.

**Contracts.**

**1866.** W. L. Lampman, furnishing timber; failed to fulfill, **66**, iv, 26.

**1868.** M. Z. Lampman, materials and labor, **68**, 152.

**1869.** William Nicolls, materials and labor, **70**, 178.

**1872.** D. E. Bailey, materials and labor, **73**, 337.

**1873.** D. E. Bailey, dredging, 35 cents per c. y., and materials and labor, **73**, 337.

**1874.** Cartwright, McCurdy & Co., iron, **73**, 334–337; **74**, 220. John Stang,

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[a] Surveys—Reports, Nov. 26, 1827, estimate, $14,465.20; 1828, estimate, $25,834.22. (H. Doc. No. 482, 55th Cong., 2d sess

**BLACK RIVER (LORAINE) HARBOR, OHIO**—Continued.

materials and labor, **75**, 299, 300. Cartwright, McCurdy & Co., iron, **75**, 299, 300.

**1875.** Smith & Sims, dredging, 28 cents per c. y., **75**, 299, 300; **76**, ii, 557.

**1881.** J. Stang, construction of pile revetment, **81**, 2308; modified in 1883 to cover repairs, **83**, 1902. James Rooney, jr., dredging, 24 cents per c. y., **81**, 2308.

**1884.** J. Stang, pier repairs, **85**, 2224. Stang & Gillmore, dredging, 21 cents per c. y., **85**, 2224.

**1886.** Stang & Gillmore, dredging, 25½ cents per c. y., and repairs to piers, **87**, 2313, 2315.

**1888.** B. S. Horton, pier extension and repair, $9,162.90, **89**, 2319.

**1889.** O. Townsend, dredging, 35 cents per c. y., **90**, 2776.

**1890.** J. Stang, pier extension and repair, $2,184.75.

**1891.** J. Stang, pier extension and repair, $7,029.80, **91**, 2851.

**1893.** J. Stang, repair and extension of piers, approximate total of bid, $16,000, **93**, 3074.

**1895.** J. Stang, pier extension, approximate total of bid, $6,390.86, **95**, 3099.

**1899.** E. J. Hingston, dredging, 14 cents per c. y. ($25,000), **1900**, 4058.

**Documents.** (Not printed in reports.)

Report of Col. Cram, dated Mar. 31, 1865, **66**, 23.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 5; ii, 41; iii, 5, 33; **67**, 29; **68**, 40; **69**, 37, 40, 48; **70**, 48; **71**, 46; **72**, 43, 44; **73**, 43, 122; **74**, 49; **75**, 55, 151; **76**, 107, 108, 142; **77**, 114; **78**, 129; **79**, 162; **80**, 226; **81**, 309; **82**, 303; **83**, 311; **84**, 314; **85**, 339; **86**, 333; **87**, 299; **88**, 273; **89**, 325; **90**, 294; **91**, 369; **92**, 349; **93**, 400; **94**, 374; **95**, 408; **96**, 362; **97**, 457; **98**, 446, 454; **99**, 529; **1900**, 594.

ENGINEERS IN CHARGE:

Col. T. J. Cram, 1864–68. **66**, 13. Reports, **66**, 13, 23–25, iv, 26, 73–75; **67**, 142, 148, 230–233; **68**, 150–152.

Maj. W. McFarland, 1869–70. Reports, **69**, 132; **70**, 176–178.

Maj. G. L. Gillespie, 1871–72. **71**, 189. Reports, **71**, 193; **72**, 229, 239.

Maj. F. Harwood, 1873–74. Reports, **73**, 334; **74**, 220.

Lt. Col. C. E. Blunt, 1875–76. Reports, **75**, 229; **76**, 556.

Maj. N. Michler, 1876–79. Reports, **77**, 962; **78**, 1258; **79**, 1674.

Maj. J. M. Wilson, 1878–82. Reports, **79**, 1689; **80**, 2127; **81**, 2306; **82**, 2396.

Maj. L. C. Overman, 1882–92. Reports, **83**, 1902; **84**, 2094; **85**, 2223; **86**, 1861; **87**, 2312; **88**, 1999; **89**, 2317; **90**, 2775; **91**, 2849.

Lt. Col. J. A. Smith, 1892–. Reports, **92**, 2501; **93**, 3072; **94**, 2405; **95**, 3097; **96**, 2937; (Col.), **97**, 3072; **98**, 2658, 2717; **99**, 3055; **1900**, 4054.

ASSISTANTS:

Capt. G. J. Lydecker, **68**, 151.

Capt. M. B. Adams, **75**, 53; **76**, 106.

**Estimates.** (See *Plans* and *Projects.*)

(Original not known.)

By Col. Cram, for repairs to east and west piers, $19,883.09, **66**, 23. For annual repairs, $1,500, **68**, 150, 151.

By Maj. McFarland, annual repairs, $1,000, **69**, 132; **70**, 176.

By Maj. Gillespie, annual repairs, $1,000, **71**, 193. For extension of piers and dredging, $61,000, **72**, 239.

By Maj. Harwood, for completion, $30,000, and for annual repairs and dredging, $4,000, **73**, 335. Additional for completion, $10,000, **74**, 220.

By Lt. Col. Blunt, for a breakwater for new harbor of refuge, $1,000,000. Not recommended, **75**, 300.

**Operations.**[a]

**1865–66.** Repairs of piers and extension of inner end of east pier, **66**, iv, 26.

**1869–70.** Slight repairs to piers, by contract, **70**, 176.

**1870–71.** Slight repairs, **71**, 46.

**1872–73.** Extension of east pier 165 f., and west pier 150 f., and dredging 23,000 c. y., by contract, **73**, 334.

**1873–74.** Pier extension by contract, 7 cribs sunk, and superstructure over 12 cribs completed; also dredging the outer bar, by hired labor, **74**, 220.

**1874–75.** 7 cribs sunk, completing the east pier, **75**, 55.

**1875–76.** Completion of the west pier extension, and dredging 21,996 c. y.; repairs, by day labor, to the west pier, **76**, ii, 557.

**1876–77.** Repairs and extension of inner end of east pier, **77**, 962.

**1878–79.** Repairs to east and west piers, **79**, 172, 1674, 1690.

**1879–80.** Repairs to piers by hired labor, **80**, 2131.

**1880–81.** Minor repairs to piers, **81**, 2306.

**1881–82.** 10,673 c. y. dredged, 400 l. f. pile revetment built at inner end east pier, and minor repairs made to piers, **82**, 2396.

**1882–83.** Minor repairs to piers, 428 l. f. west pier superstructure removed, **83**, 1903.

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[a] History of operations to 1879, **78**, 1258; **79**, 1689.

## BLACK RIVER (LORAINE) HARBOR, OHIO—Continued.

**1883–84.** 693 l. f. of superstructure of west pier removed, 308 l. f. pile revetment at inner end east pier rebuilt, 138 l. f. of west pier superstructure repaired; minor repairs to both piers, **84,** 2095.

**1884–85.** 3,331 c. y. dredged from channel, 656 l. f. of east pier superstructure removed, 262 l. f. pile revetment placed on channel side of west pier, and 225 l. f. of pile revetment placed on both sides of east pier, **85,** 2224.

**1886–87.** 3,994 c. y. dredged from bar at entrance, and repairs made to piers, **87,** 2313.

**1887–88.** Pier repair continued under contract, **88,** 2000.

**1888–89.** Extension of west pier, and repairs to east and west piers continued under contract, **89,** 2317.

**1889–90.** 2,000 c. y. dredged, **90,** 2776.

**1890–91.** 6,400 c. y. dredged from the channel between the piers; east pier extension and dredging in progress, **91,** 2849.

**1891–92.** East pier extension completed; minor repairs to superstructure of old piers, **92,** 2501.

**1892–93.** 2,974 c. y. dredged, **93,** 3073.

**1893–94.** East and west piers repaired, and dredging done through the bar, **94,** 2406–2407.

**1894–95.** Both piers repaired, extension of west pier in progress, and 9,405 c. y. dredged, **95,** 3098.

**1895–96.** Pier extension of previous year completed, **96,** 2937.

**1896–97.** 39,684 c. y. dredged, and reconstruction of west pier in progress, **97,** 3072.

**1897–98.** West pier extended, **98,** 2658, and 4,184 c. y. dredged, **98,** 2659.

**1898–99.** 66,780 c. y. dredged, **1900,** 4055.

**Physical characteristics.**

Drift of sand from the east beach into the harbor, with the usual drift of sand in the littoral current around the end of the west pier, **72,** 239; **73,** 335; **75,** 300.

Description of, **96,** 2938; **98,** 2718, 2721.

**Plans.** (See also *Estimates* and *Projects.*)

For breakwater for a harbor of refuge, submitted by Lt. Col. Blunt, but not recommended, **75,** 300.

**Projects.** (See *Estimates* and *Plans.*)

History of the work from 1828 to 1880, **80,** 2131.

Original, by Capt. Maurice, 1828, for parallel piers of crib work, brushwood, and loose stone, running nearly at right angles to the coast line, into the lake. See map, **66,** and partial history of, **66,** 23; **77,** 962; **79,** 1680.

By Col. Cram, in 1865, for repairs to piers and extension of inner end of east pier, **66,** iv, 26; **67,** 142.

By Maj. Gillespie, for repairs and extension of the piers and dredging to obtain 14 f. depth of water, **72,** 229–239.

By Lt. Col. Blunt, to obtain 15 f. depth of water, **74,** 220. Completed in 1876, **76,** ii, 557. For repairs to east pier and shore protection at the inner end, **76,** ii, 557.

Projects between 1828 and 1880 proposed, by pier extension and dredging, the formation of a channel entrance of navigable width and not less than 14 f. deep. In 1880 an expenditure of $175,138.92 had resulted in the formation of a channel not less than 15 f. deep, **80,** 226, 2132.

In 1880 Maj. Wilson proposed the extension of the piers to the 16-f. curve in the lake, with the renewal of 2,000 l. f. of old superstructure; estimated cost, $42,000, **80,** 2131; increased in 1882 to $45,000, **82,** 2397; increased in 1884 to $64,000, on account of unexpected repairs, **84,** 2096.

In 1892 it was understood by the officer in charge that Congress by the appropriation of 1892 approved a project for extending the piers to 17 f. depth, **93,** 3072.

By Lt. Col. Smith, in 1896, for expending the appropriation of 1894 in extending the west pier, and for dredging and repairs, using $7,500 for the former, and $2,500 for the latter, **96,** 2938.

By Lt. Col. Smith, in 1896, for dredging a channel between the piers and into the lake to a depth of 19 f. and width of 150 f., at an actual cost of about $6,000, **97,** 3072.

By Lt. Col. Smith, in 1896, for expending the appropriation of 1896 in removing and rebuilding 396 l. f. of the west pier, **97,** 3072.

In 1897 Col. Smith estimated it would cost $590,500 or $695,500 to improve the harbor, **98,** 2721.

By Col. Smith, 1897, for extension of east breakwater 1,500 f. and of west breakwater 1,800 f.; for two pierheads; for extending and rebuilding piers; and for dredging anchorage and channel; estimated cost, $695,000, **98,** 2721; **99,** 3055; **1900,** 4054–4062. Drawings, **1900,** 4054. Act of June 6, 1900, provided that the cost of any part of the work should not exceed by more than one-tenth the original estimate, **1900,** 4050.

Estimated cost of the entire project, 1900, $705,350, **1900,** 4057.

## BLACK RIVER (LORAINE) BARBOR, OHIO—Continued.

Type of work found, 1889, most suitable for breakwaters, **1900**, 4055.

**Surveys.**

By direction of Maj. Raynolds, 1865, **66**, 25.

By direction of Lt. Col. Blunt, 1874, for breakwaters for harbor of refuge. Report, **75**, 300.

In 1892–93 a hydrographic survey and a survey of the channel and its approaches were made by Lt. Col. Smith, **93**, 3073, and another survey of the channel was made in 1895 by the same officer, **95**, 3098.

Survey of the harbor, with a view to providing better access for boats and for their safety, ordered by act of June 3, 1896, made by Col. Smith, 1897 (see *Projects*), **98**, 2717.

MAPS:

Of Northern and Northwestern Lakes, showing location of harbor, and of the harbor, showing its condition in Sept., 1865; **66**, 6.

**81**, 2308; **91**, 2850; **94**, 2407.

PHOTOGRAPHS. **98**, 2660, 2722.

DRAWINGS. (See *Projects*, *1897*.)

## BLACK ROCK HARBOR, CONN.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1836,[b] | $10,000, | act July 4, **95**, 798. |
| 1838,[b] | 11,550, | act July 7, **95**, 798. |
| 1882,[c] | 350, | **95**, 798. |
| 1884, | 20,000, | **85**, 655. |
| 1886, | 5,000, | **86**, 647. |
| 1888, | 10,000, | **88**, 560. |
| 1890, | 5,000, | **90**, 642. |
| 1892, | 5,000, | **92**, 691. |
| 1894,[d] | 3,500, | **94**, 665. |
| 1894, | 2,500, | **95**, 798. |
| Total, | 72,900 | |

**Commerce.**

Important, **84**, 666, 669.

Description of, **95**, 858.

Increasing at 1894–95, **95**, 859.

**Contracts.**

**1885.** J. A. Bouker, construction of breakwater, $1.22 per t. of stone. H. & A. Beardsley, dredging, 15 cents per c. y., **85**, 654.

**1886.** E. Brainard, dredging, 9 cents per c. y., **87**, 613.

**1889.** J. H. Fenner, dredging, 16 cents per c. y., **89**, 705.

**1891.** G. B. Beardsley, dredging, 14.6 cents per c. y., **91**, 785.

**1892.** A. J. Beardsley, dredging, 17 cents per c. y., s. m. ($6,800), **93**, 944.

**1894.** D. V. Howell, stone, $1.37 and $2.27 per ton ($1,820), **95**, 799.

**1895.** D. V. Howell, stone, $2.57 and $1.47 per ton ($643), **95**, 799.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 99; **85**, 86; **86**, 87; **87**, 49; **88**, 51; **89**, 63, 70; **90**, 57; **91**, 70; **92**, 75; **93**, 80; **94**, 72; **95**, 82, 93.

ENGINEERS IN CHARGE:

Lt. Col. W. McFarland, 1884–86. Reports, **84**, 666; **85**, 653.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 646; **87**, 613; (Col.), **88**, 558; **89**, 702, 741; **90**, 640; **91**, 784; **92**, 689.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 942; **94**, 663; (Col.), **95**, 796, 856.

ASSISTANT. H. N. Babcock. Report, **84**, 667.

**Operations.**

**1884–85.** 4,974 t. stone placed in breakwater; 19,984 c. y. dredged from Cedar Creek Channel, of which half the cost was paid by private parties, **85**, 654.

**1885–86.** 5,440 t. stone placed in breakwater, partly completing the work for the whole length, **86**, 647.

**1886–87.** 21,500 c. y. dredged from Cedar Creek Channel, **87**, 613.

**1887–88.** 24,868 c. y. dredged from channel, **88**, 559.

**1889–90.** 58,000 c. y. dredged, **90**, 641.

**1891–92.** 28,000 c. y. dredged, **92**, 690.

**1893–94.** 25,000 c. y. dredged, 115 l. f. sea wall at Fayerweather Island rebuilt, and 160 l. f. added, using altogether 1,384 t. stone, **94**, 665.

**1894–95.** Three spur jetties built, and riprapping done, **95**, 797.

**Physical characteristics.**

Description of, **84**, 668; **88**, 558; **89**, 741; **93**, 942, **95**, 857.

The harbor includes the lower harbor, about 1½ miles long, and the upper harbor, consisting mainly of two tidal inlets, **95**, 857.

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[a] Survey.—Report Feb. 15, 1827, estimate $6,201.20, and June 9, 1831, estimate, $10,900. H. Doc. No. 482, 55th Cong., 2d sess.

[b] Sea wall, Fayerweather Island.

[c] Survey.

[d] Allotment, from examinations, surveys, and contingencies, for repair of old sea wall.

## BLACK ROCK HARBOR, CONN.—Continued.

**Private work.**

Dredging in 1884–85, by private interests, **85**, 86, 654 (see *Operations, 1884–85*).

**Projects.**

In 1836–38, $21,550 was expended in closing a breach across Fayerweather Island, **85**, 653.

By Lt. Col. McFarland, 1883, for the construction of a riprap breakwater 2,700 f. long, extending from Fayerweather Island to the mainland, and dredging a channel 3,300 f. long, 80 f. wide, and 6 f. deep at m. l. w., up Cedar Creek; estimated cost, $80,000, **84**, 667, 668; **85**, 653; **87**, 613; **92**, 690.

**Surveys.**

Ordered by act of Aug. 2, 1882, made, 1883, under the direction of Lt. Col. McFarland, **84**, 666.

Examination for breakwater to Penfield Reef and south from Fayerweather Island ordered by act of Aug. 11, 1888, made, 1888, under direction of Col. Houston, **89**, 741.

Examination ordered by act of Aug. 17, 1894, made in that year by Lt. Col. Robert (report favorable), **95**, 856.

MAPS. **85**, 654, **93**, 944.

## BLACK ROCK HARBOR, N. Y. (Pier extension.) (See *Buffalo Harbor.*)

**Appropriations.**[a]

| | |
|---|---|
| Mar. 2, 1829, | $30,000 |
| Apr. 23, 1830, | 3,198 |
| Mar. 2, 1831, | 1,800 |
| July 3, 1832, | 5,100 |
| June 28, 1834, | 12,000 |
| Total, | 52,098 |

## BLACK WALNUT HARBOR, MD.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 143.

ENGINEER IN CHARGE: Maj. W. F. Smith, U. S. Agent, 1893. Report, **93**, 1237.

ASSISTANT: A Stierle. Report, **93**, 1240.

**Physical characteristics.**

Description of, **93**, 1240.

**Surveys.**

Examination ordered by act of July 13, 1892, made under the direction of Maj. Smith, 1892 (report unfavorable), **93**, 1239.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS. (See *Warrior River.*)

| Parts. | Appropriations. |
|---|---|
| A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss | $1,154,800 |
| B.—Warrior River, Ala. and Miss | 580,000 |
| C.—Tombigbee River, above Columbus, Miss | 6,000 |
| D.—Black Warrior River, Tuscaloosa to Daniels Creek, Ala | 290,574 |
| E.—Tombigbee River, Walkers Bridge to Fulton, Ala. and Miss | 8,000 |
| F.—Tombigbee River, below Demopolis, Ala. and Miss | 200,000 |
| G.—Tombigbee River, Demopolis to Columbus, Ala. and Miss | 110,000 |
| H.—Tombigbee River, Fulton to Columbus, Ala. and Miss | 17,000 |
| Total | 2,311,374 |

### Part A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss. (Including survey for water communication with the Tennessee by way of Big Bear Creek.) (See *Black Warrior River, Ala.* (Part D), and *Tombigbee River above Columbus, Miss.* (Part C).)

**Appropriations.**

1870, [c]$4,800, **71**, 573 (survey).
1872, [b][c]10,000, **73**, 67.
1875, [d]25,000, **76**, 73.
1876, [d]15,000, **76**, 74.

**Appropriations**—Continued.

1878, [d]28,000, **78**, 81, 593.
1878, [c]12,000, **78**, 81, 594.
1879, [d]20,000, **79**, 104.
1879, [c]10,000, **79**, 105.

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[a] H. Doc. No. 482, 55th Cong., 2d sess.; Treas. Doc. 373, 1882.

[b] Act of Congress, Mar. 3, 1873, transferred appropriation of 1872 to Tombigbee River, Miss.

Districts, and total appropriations for each district to 1892—

[c] Tombigbee River, $36,800.

[d] Tombigbee and Black Warrior rivers, $88,000.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss., etc.—Continued.

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1880 | [a] $20,000 | **80**, 1090. |
| | [b] 12,000 | |
| | [c] 15,000 | |
| 1881, | [d] 25,000, | **81**, 1211. |
| 1882 | [e] 10,000 | **82**, 1294. |
| | [b] 7,500 | |
| | [f] 7,500 | |
| | [g] 5,000 | |
| 1884 | [h] 10,000 | **84**, 1210. |
| | [i] 15,000 | |
| | [j] 12,000, | **84**, 1206. |
| 1886 | [h] 18,750, | **86**, 1196. |
| | [c] 11,250 | **86**, 1199. |
| | [h] 7,500 | |
| 1888 | [c] 6,000, | **88**, 1208. |
| | [h] 6,500, | **88**, 1205. |
| | [k] 4,000, | **88**, 161. |
| | [l] 18,000, | **88**, 1203. |
| | [m] 100,000, | **88**, 1199. |
| 1890 | [n] 15,000. | |
| | [c] 150,000, | **90**, 1696. |
| | [l] 100,000, | **90**, 1700. |
| | [k] 4,000, | **90**, 1701. |
| | [h] 6,000, | **90**, 1702. |
| 1892 | [m] 200,000, | **92**, 1444. |
| | [d] 75,000, | **92**, 1446. |
| | [k] 3,000, | **92**, 1448. |
| | [h] 6,000, | **92**, 1449. |
| | [o] 125,000, | **92**, 1450. |
| | [n] 35,000, | **92**, 1451. |

Total, 1,154,800

List of Appropriations:

Tombigbee, below Vienna, **90**, 1703.

Tombigbee, from Vienna to Fulton, **89**, 1439.

Black Warrior, from Tuscaloosa to Daniels Creek, **89**, 1198.

Warrior and Tombigbee, **92**, 1445.

Warrior River, **92**, 1445.

**Commerce.**

Important, **73**, 552; **75**, ii, 16, 24, 27; **79**, 832.

Benefit of improvement, **81**, 1205, 1208, 1210; **82**, 1294; **83**, 1015; **85**, 1348.

Timber shipments on Tombigbee, 1888 to 1890; decrease in freight and transportation expenses, **89**, 1438; **90**, 1701.

Importance of the improvement to the coal and iron interests on the Warrior River, **92**, 1443.

**Contracts.**

**1888.** Wm. Miller, constructing lock-tender's house (Black Warrior), $1,990, **88**, 1199.

**Engineers.**

Chief of Engineers. Reports, **70**, 31; **71**, 69; **73**, 62, 67; **74**, 70; **75**, 76, 77; **76**, 73; **77**, 72; **78**, 81; **79**, 104, 105, 106; **80**, 138; **81**, 186; **82**, 183; **83**, 195; **84**, 203; **85**, 108; **86**, 206; **87**, 173–178; **88**, 160–166; **89**, 187–194; **90**, 168–175; **91**, 212-215; **92**, 206–209.

Engineers in Charge:

Maj. C. B. Reese, 1870, **71**, 68, 572.

Capt. A. N. Damrell, 1870. **71**, 68, 572.

Col. J. H. Simpson, 1870–72. Report, **71**, 572, 573.

Lt. Col. W. F. Raynolds, 1873, **73**, 66.

Capt. A. N. Damrell, 1873. Report, **73**, 697.

Maj. W. McFarland, 1872–75. Reports, **73**, 548; **74**, 579; **75**, 791, 803.

Capt. A. N. Damrell, 1875. Reports, **75**, ii, 16; **76**, 496; **77**, 416; **78**, 593, 594; **79**, 830, 833; (Maj.) **80**, 1085; **81**, 1203; **82**, 1282; **83**, 1011; **84**, 1204; **85**, 1345; **86**, 1193; **87**, 1322; **88**, 1198–1227; **89**, 1433–1440; **90**, 1696–1716; **91**, 1776–1784; **92**, 1440–1451.

Assistants:

Henry C. Fillebrown. Report, **71**, 574, 575.

T. Pearsall, **71**, 572.

P. Robinson. Reports, **73**, 548; **74**, 580; **75**, 806.

Horace Hearding. Report, **75**, ii, 17.

**Estimates.** (See *Plans* and *Projects*.)

By P. Robinson, 1873, removing obstructions from Aberdeen to Columbus, channel 60 f. wide and 2½ f. deep, $92,500, **73**, 549. Slack-water navigation, $300,000, **73**, 550. Slack-water navigation

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Districts, and total appropriations for each district to 1892—Continued.

[a] Black Warrior River, $20,000.
[b] Tombigbee, Columbus to Vienna, $19,500.
[c] Tombigbee, below Vienna, $32,250.
[d] Warrior and Tombigbee rivers, $100,000.
[e] Warrior, below Tuscaloosa, $28,750.
[f] Tombigbee, Vienna to Demopolis, $7,500.
[g] Tombigbee, below Demopolis, $5,000.
[h] Tombigbee, Fulton to Vienna, $36,000.
[i] Tombigbee, below Fulton, $15,000.
[j] Warrior River, $12,000.
[k] Tombigbee, Fulton to Walkers Bridge, $11,000.
[l] Black Warrior, Demopolis to Tuscaloosa, $118,000.
[m] Black Warrior, Tuscaloosa to Daniels Creek, $450,000.
[n] Tombigbee, Demopolis to Columbus, $50,000.
[o] Tombigbee, mouth to Demopolis, $125,000.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss., etc.—Continued.

between the Tombigbee and Tennessee rivers, $1,705,312, **75**, 805, 808.

By H. Hearding, 1875, improvement of Lower Black Warrior, $36,450, $151,103, **75**, ii, 17, 20, 23. Improvement of Upper Black Warrior River, $431,000, **75**, ii, 24.

By Capt. Damrell, 1876, improvement of Tombigbee and Black Warrior rivers, $172,603, **76**, 497. Foregoing estimate increased to, 1879, $250,000, **79**, 832.

**Operations.** [a]

**1872–73.** Removal of 250 snags from Tombigbee River, between mouth and Demopolis, **73**, 67, 697.

**1873–74.** Removal of obstructions from Tombigbee River, between Aberdeen and Cotton Gin Port, **74**, 70, 580.

**1874–75.** Removal of obstructions continued to Barris Ferry, **75**, 76, 791.

**1875–76.** On Tombigbee, 417 snags removed, 361 c. y. of rock excavated, 4,708 c. y. dredged, and 4,533 l. f. of jetties and 1,298 l. f. of dams built; also 791 f. of shore protection constructed; 21 bars improved, **76**, 73, 497.

**1876–77.** On Tombigbee, 798 snags removed, 400 c. y. dredged, and 5,076 l. f. of jetties constructed; also 1 wreck removed; 12 bars improved, **77**, 72, 417.

**1877–78.** Warrior River cleared of obstructions to Log Shoals; channel 2½ f. deep from mouth to Eastport, **78**, 81, 593.

**1878–79.** On Warrior River, 713 snags removed, 2,190 l. f. of jetties built, and 7 bars improved. On Tombigbee River, 911 snags removed and 3,305 l. f. of jetties built, **79**, 831, 833.

**1879–80.** Obstructions removed and wing dams built on Tombigbee between Columbus and Demopolis, **80**, 1088; **82**, 1288.

**1880–81.** 586 trees and logs removed and 851 l. f. wing dams built on the Black Warrior River, **81**, 1204. On Tombigbee River, between Columbus and Vienna, 5,656 l. f. of wing dams built, 1,541 l. f. shore protection placed, and 2,482 trees and logs removed, **81**, 1207.

**1881–82.** On Black Warrior, 10,111 l. f. of dams and jetties built, 4,608 logs and trees removed, **82**, 1284. On Tombigbee, below Columbus, 9,336 l. f. of wing dams built, 6,406 logs and trees removed, 1,100 c. y. rock blasted, **82**, 1290.

**1882–83.** On Black Warrior, 7,969 l. f. jetties built and repaired, 3,200 l. f. bank protected, 2,607 trees and logs removed, **83**, 1014. On Tombigbee, below Columbus, 1,020 l. f. wing dams built, 5,281 trees and logs, and 1,900 c. y. of rock removed, **83**, 1018.

**1883–84.** On Black Warrior, 1,354 logs and trees removed, **84**, 1204. On Tombigbee, below Columbus, 800 snags and trees removed and 1,685 l. f. of wing dams built, **84**, 1208.

**1884–85.** On Black Warrior, 567 trees and snags removed and 500 cords of brush cut and piled, **85**, 1346. On Tombigbee a barge was built, 6,027 trees and logs removed, and one-half mile of bank protected, **85**, 1350.

**1885–86.** On Black Warrior, 250 logs removed and caving bank protected, **86**, 1193. On Tombigbee, 1,333 logs and trees were removed, **86**, 1197.

**1886–87.** On Warrior River a survey in progress, **87**, 1324.

**1887–88.** 1,040 snags removed from the channel, and 432 trees cut from the banks on Tombigbee below Vienna, **88**, 1,207. 871 snags and stumps removed from the channel and 242 trees from the banks, clearing 25 miles of river and completing the projected improvement between Vienna and Fulton, **88**, 1205; 3,015 snags removed from the channel, and 775 trees cut from the banks on Black Warrior between Demopolis and Tuscaloosa, **88**, 1202. Construction of lock and dam No. 1 begun on Black Warrior between Tuscaloosa and Daniels Creek, **88**, 1199.

**1888–89.** Snags and trees removed on Tombigbee between Fulton and Walkers Bridge, **89**, 1438. 7,811 c. y. stone quarried, 2,364 c. y. stone cut, 1,438 c. y. stone laid, and 816 c. y. rock and 1,500 c. y. earth excavated in lock and dam construction on Black Warrior between Tuscaloosa and Daniels Creek, **89**, 1434.

**1889–90.** Removal of obstructions continued in Tombigbee between Walkers Bridge and Fulton, **90**, 1701. 7,510 c. y. masonry laid, 4,100 c. y. stone quarried, 950 c. y. stone cut, 1,541 c. y. rock and 3,780 c. y. earth excavated, and 1,400 c. y. rock and earth backing placed behind bank wall in lock and dam construction on Black Warrior between Tuscaloosa and Daniels Creek, **90**, 1697.

**1890–91.** Construction and repair of plant for snagging on the Warrior River, **91**, 1778. 454 trees pulled, 2,886 trees cut, and 1,725 logs and stumps removed on Tombigbee between Walkers Bridge and Fulton, **91**, 1779. Prepara-

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[a] Above Columbus, from Aberdeen to Waverly, 63 miles, high-water navigation obtained at 1870, **79**, 105, 831, 833. History of operations, to 1879, **74**, 579; **79**, 830, 833.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss., etc.—Continued.

tion of plant for work on Tombigbee between Fulton and Vienna, **91**, 1781. Snags, logs, and trees removed from Tombigbee from its mouth up to Demopolis, **91**, 1783. 3,446 c. y. of stone quarried, 1,038 c. y. cut, and 567 c. y. laid; 3,132 c. y. rock excavation in lock pit; 3,700 c. y. of earth and rock filling behind lock wall in construction of lock and dam in Black Warrior River between Tuscaloosa and Daniels Creek, **91**, 1786.

**1891–92.** 960 c. y. rock and 440 s. y. of paving used in bank revetment and dam at lock No. 1; 2,793 c. y. rock and earth excavated in foundation; 3,475 c. y. rock quarried, and 6,121 c. y. of masonry laid at lock No. 2; 681 c. y. stone quarried, at lock No. 3, Black Warrior from Tuscaloosa to Daniels Creek, **92**, 1442. 766 snags and 384 overhanging trees removed on Warrior and Tombigbee rivers, **92**, 1446. 3,277 snags removed from channel, and 4,101 trees cleared from the banks on Tombigbee between Fulton and Vienna, **92**, 1449. 600 snags, 511 overhanging trees, 2,944 c. y. of rock, and 3 wrecks removed, and 1,584 l. f of jetty repaired on Tombigbee from its mouth up to Demopolis, **92**, 1450. 2,672 snags and 7,406 overhanging trees removed from Tombigbee between Demopolis and Columbus, **92**, 1451.

**Physical characteristics.**

Description of, **71**, 573, 575; **73**, 551.

Obstructions to navigation, **71**, 576.

Description of the Black Warrior River, **75**, ii, 16, 17, 18–23; **83**, 1011.

Tables of distances, **73**, 551; **85**, 1347.

Table of water levels and distances on Tombigbee River, **75**, 804, 807.

Lowest summit level, **75**, 806.

Caving banks on Tombigbee River, **80**, 1089.

Description of Tombigbee and Black Warrior rivers, **88**, 1200, 1206; **90**, 1716.

**Plans.** (See *Estimates* and *Projects*.)

T. Pearsall, 1871, reported that from Columbus, Miss., to Demopolis (the confluence of the Tombigbee with the Mobile River) no permanent improvement to navigation could be made, **71**, 572.

H. C. Fillebrown, 1871, reported that the river could be temporarily improved by the removal of snags and sawyers; estimated cost, $21,500, **71**, 573, 576, 577.

By Col. Simpson, 1871, for the removal of the railroad bridge at Jones Bluffs to a point 300 y. farther down the river, **71**, 573.

P. Robinson, 1873, Fulton to Columbus, Miss., slack-water navigation or excavating channel reported impracticable, **73**, 549, 550. Slack-water navigation, 1875, between the Tombigbee and the Tennessee rivers; estimated cost, $1,705,312, **75**, 803, 807; reported impracticable, **75**, 805, 809.

By H. Hearding, slack-water navigation on the Upper Warrior River by locks and dams and by canal; estimated cost, $431,000, **75**, ii, 23, 24. For the improvement of the Lower Black Warrior from Demopolis to Tuscaloosa, to procure a channel 80 f. wide and 4 f. deep by the removal of obstructions and construction of jetties, estimated cost, $151,103; or for a channel 50 f. wide and 3 f. deep, estimated cost, $36,450, **75**, ii, 22, 23.

For improvement from Demopolis to Tuscaloosa on the Black Warrior River by construction of dams and pneumatic gates, snagging, bank revetment, and bar improvement; estimated cost, $577,000, **91**, 1779.

**Private (State) work.**

State of Alabama contracted with Mr. McCarty for the removal of obstructions from the Tombigbee River for $20,000, **71**, 575.

**Projects.** (See *Estimates* and *Plans*.)

P. Robinson, 1873, reported impracticability of permanent improvements above Columbus; proposed temporary improvement by the removal of snags, logs, etc.; estimated cost, $35,000; approved by Maj. McFarland, **73**, 548.

By Col. Simpson, for removal of obstructions, snags, sawyers, etc., from the mouth to Columbus; approved by Chief of Engineers, **73**, 697.

Capt. Damrell, 1875, recommended H. Hearding's plan for the improvement of the Lower Black Warrior and the Tombigbee by the removal of obstructions and the construction of jetties and parallels and by protection of the shore; estimated cost for channel 80 f. wide and 4 f. deep on Black Warrior River, $151,103; for Tombigbee River, $21,500 (see Plans), **75**, ii, 17; **76**, 496; approved by the Chief of Engineers, **75**, ii, 17; **76**, 496; **80**, 1085.

Original project amended, 1879, so as to provide a 3-f. channel at m. l. w. on the Tombigbee River, between Demopolis and Columbus; estimated cost, $250,000, **79**, 832; **80**, 1088.

By Maj. Damrell, 1889, for slack-water navigation from the mouth of the Tombigbee River to Demopolis, to be secured with three locks and dams, dredging, bank

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part A.—Black Warrior, Warrior, and Tombigbee rivers, Ala. and Miss., etc.—Continued.

revetment, and snagging; estimated cost, $508,898, **92**, 1450.

By Maj. Damrell, 1873, for improvement of the Tombigbee River between Fulton and Columbus, 144 miles, by removing snags and overhanging trees, to secure high-water navigation.

In 1879, Maj. Damrell proposed the improvement of the section between Columbus and Vienna, so as to give a low-water channel with a minimum depth of 3 f. and a width of 40 f. by clearing the river bed and banks of obstructions, and deepening the bars by dikes and jetties; total required for completion of improvement from the mouth to Fulton, $205,000, **88**, 1204; **89**, 1439; **90**, 170.

By Maj. Damrell, 1888, to secure a channel for high-water navigation from Fulton up to Walkers Bridge by removing snags and overhanging trees, at an estimated cost of $11,000, **89**, 1438.

By Maj. Damrell, 1875, for improvement of the Black Warrior River, forming a channel 80 f. wide and 4 f. deep from its junction with the Tombigbee at Demopolis to Tuscaloosa, 140 miles, by removing obstructions, dredging, blasting, and wing-dam construction; estimated cost, $151,103, **75**, 17; **80**, 1085.

By Board of Engineers, 1886, for slack-water navigation between Tuscaloosa and Daniels Creek, 15 miles, with five locks and fixed dams; estimated cost, $741,670, **88**, 1198.

By Maj. Damrell, 1889, for slack-water improvement from Demopolis to Columbus on the Tombigbee with dams with pneumatic gates, and for bank revetment, snagging, and bar improvement; estimated cost, $779,408, **90**, 1720, 1721; **92**, 1451.

**Surveys.**

By H. C. Fillebrown, 1870, of Tombigbee River from mouth to head of navigation. (See *Appropriation*, 1870.) **71**, 573, 574. Examination by T. Pearsall, **71**, 31, 572.

Of Tombigbee, 1872, by P. Robinson, between Fulton and Columbus, **73**, 62, 548.

By H. Hearding, 1874, of Black Warrior River, **75**, ii, 16, 17.

By P. Robinson, 1875, for a water communication from the Tombigbee River to the Tennessee River, by way of Big Bear Creek, **75**, 77, 803, 806.

Of Warrior River, 1879, from Tuscaloosa to Forks of the Sipsey River, **79**, 106.

Examination for continuous navigation from Vienna, Ala., to Walkers Bridge, Miss., ordered by act of August 5, 1886, made, 1887, under direction of Maj. Damrell, **88**, 1226, 1227.

Survey of Warrior River from Tuscaloosa to Demopolis, and of the Tombigbee River from its mouth up to Cotton Gin, ordered by act of August 11, 1888, made, 1889, under direction of Maj. Damrell, **90**, 1719.

### Part B.—Warrior River, Ala. and Miss. (See *Part A*.)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1894, | $40,000, | **95**, | 1693. |
| 1896, | 70,000, | **96**, | 1436. |
| 1899, | 220,000, | **99**, | 1710. |
| 1900, | 200,000, | **1900**, | 2182. |
| Total, | [a] 530,000 | | |

**Commerce.**

Description of, **97**, 1682.

A large traffic in coal growing, **97**, 1682.

A large rafting business done, 1900, on the lower part of the river for mills in Demopolis, **1900**, 2182.

**Contract.**

**1900.** Christie, Lowe & Heyworth, constructing locks and dams Nos. 4, 5, and 6, $417,230.20, **1900**, 2185.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 230; **94**, 212; **95**, 237; **96**, 208; **97**, 265; **98**, 261; **99**, 305; **1900**, 346.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1875–95. Reports, **93**, 1755; **94**, 1311; **95**, 1692.

Maj. W. T. Rossell, 1896–. Reports, **96**, 1435; **97**, 1678; **98**, 1434; **99**, 1708; **1900**, 2178.

ASSISTANT. R. C. McCalla. Report, **97**, 1681.

**Operations.**

**1892–93.** Over 8,000 obstructions removed and 3 dams built, **93**, 1757.

**1893–94.** About 12,000 obstructions removed, 2,575 c. y. rock excavated, 25,099 c. y. dredged, 1,428 l. f. dams and jetties built, and 4,167 trees cut and burned in clearing, **94**, 1313.

**1895–96.** Over 10,000 obstructions removed, 9,550 c. y. gravel and 358 c. y. rock removed, 587 l. f. jetties built and repaired, 150 l. f. shore protection built, 285 l. f. dams built, and 2,500 c. y. earth excavated, **96**, 1437.

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[a] See foot-note, appropriations, Part A.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part B.—Warrior River, Ala. and Miss.—Continued.

**1896–97.** Dredging in progress; over 28,000 obstructions removed, 57,180 c. y. rock, clay, and gravel excavated, and 2,743 l. f. training walls and dams built, **97**, 1685.

**1897–98.** Continuance of work of previous year, **98**, 1435.

**1898–1900.** Borings for lock sites, **99**, 1708; **1900**, 2179.

**Physical characteristics.**

Description of, **97**, 1681.

Gauge readings, **97**, 1681; **99**, 1708.

Borings, **99**, 1708; **1900**, 2179.

Rainfall, Apr. 15–16, 1900, caused highest flood known, **1900**, 2178, 2186.

**Surveys.**

Minor surveys made by Maj. Rossell, **98**, 1435; **99**, 1708; **1900**, 2178.

Bench marks, **1900**, 2187.

MAPS. **96**, 1436 (*Plans of dikes*); **97**, 1684; **98**, 1436; **1900**, 2182 (*Photographs*).

### Part C.—Tombigbee River, above Columbus, Miss. (See *Part A.*)

**Appropriations.**

1880, $4,000, **80**, 1092.
1881, 1,000, **81**, 1212.
1882, 1,000, **82**, 1295.

Total, 6,000

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 139; **81**, 187; **82**, 184; **83**, 196; **84**, 204.

ENGINEER IN CHARGE. Maj. A. N. Damrel, 1880–84. Reports, **80**, 1091; **81**, 1211; **82**, 1294, 1312; **83**, 1022; **84**, 1210.

ASSISTANT. H. Harding. Report, **82**, 1313.

**Operations.**

All operations with hired labor.

**1879–80.** Removal of snags and logs, **80**, 1091.

**1880–81.** 9,074 logs, trees, and stumps removed, **81**, 1212.

**1881–82.** Removal of snags and logs, **82**, 1295.

**1882–84.** Preservation of work, **83**, 1022; **84**, 1211.

**Plans.**

By Maj. Damrell for an improvement between Fulton and the junction of Browns and Mackeys creeks by removing logs, snags, and trees. Estimated cost, $11,000. **82**, 1312, 1313.

**Projects.**

By Maj. McFarland, 1873, for the temporary improvement of the Tombigbee above Columbus and to Fulton by removing obstructions. Estimated cost, $35,000. **73**, 548; **80**, 1092; **81**, 1211. Project completed, 1882, **82**, 1295.

**Surveys.**

From Fulton to Warren's mill, under direction of Maj. Damrell, 1882, **82**, 1312.

### Part D.—Black Warrior River, from Tuscaloosa to Daniels Creek, Ala. (See *Part A.*)

**Appropriations.**

1884, $50,000, **85**, 1354.
1886, 56,250, **86**, 1200.
1894, 37,500, **95**, 1691.
1896, 10,000, **96**, 1434.
1899, 50,000, **99**, 1703.
1900, 86,824, **1900**, 2169.

Total,[a] 290,574

**Commerce.**

Important, **80**, 1219; **85**, 1354.

Description of, **93**, 1753; **97**, 1674.

A large and important commerce in mineral products likely to spring up, **93**, 1753, 1754.

**Contracts.**

**1899.** Willard & Cornwell, constructing lock and dam No. 4, $163,348, **1900**, 2170.

**1900.** G. T. Eckert, constructing lock tender's house at lock No. 4, $1,400, **1900**, 2170.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 189; **85**, 210; **86**, 208; **87**, 172; **93**, 229; **94**, 211; **95**, 236; **96**, 208, 214; **97**, 264; **98**, 260; **99**, 304; **1900**, 346.

BOARD OF ENGINEERS. Convened by S. O. No. 9, C. of E., 1886, to consider the improvement of the Black Warrior River, Ala. Report, **87**, 1302.

(Col. Craighill, Lt. Col. Merrill, Majs. King, Damrell, and Post.)

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1875–95. Reports, **81**, 1218; **85**, 1354; **86**, 1199; **87**, 1299; **93**, 1751; **94**, 1310; **95**, 1691.

Maj. W. T. Rossell, 1896–. Reports,

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[a] See footnote *p*, appropriations, Part A.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part D.—Black Warrior River, from Tuscaloosa to Daniels Creek, Ala.—Continued.

**96**, 1433, 1461; **97**, 1667; **98**, 1430; **99**, 1702; **1900**, 2167.

Assistants:

E. A. Smith. Report, **81**, 1218.

N. C. McCalla, jr. Report, **97**, 1669.

**Operations.**

**1893–95.** Construction of locks Nos. 1, 2, and 3 in progress, **93**, 1753; **94**, 1310; **95**, 1692.

**1895–96.** Locks Nos. 1, 2, and 3 completed, and preparations in progress for construction of lock No. 4, **96**, 1434.

**1896–97.** Preparations continued for work on lock No. 4, **97**, 1668.

Detailed description of work done on other locks given, **97**, 1668, 1669.

**1897–98.** U. S. Engineer office in Tuscaloosa connected with locks Nos. 1, 2, and 3 by telephone, **98**, 1430.

**1898–99.** Gauges read daily; plant cared for, and plan and specifications for lock and dam No. 4 prepared, **99**, 1702.

**1899–1900.** Construction of lock and dam No. 4 in progress, **1900**, 2167.

**Physical characteristics.**

Description of, **96**, 1433, 1462.

**Plans.**

By Maj. Damrell, 1880, for slack-water navigation between Tuscaloosa and forks of Sipsey and Mulberry, with locks and dams. Estimated cost, $1,200,000. **81**, 1218, 1220; **85**, 1354; **86**, 1199.

By Maj. Damrell, 1885, for slack-water navigation between Tuscaloosa and Daniels Creek, with movable locks and dams. Estimated cost, $245,786. **85**, 1354.

**Projects.**

By Board of Engineers, 1886, for slack-water navigation between Tuscaloosa and Daniels Creek, with locks and fixed dam. Estimated cost, $567,000. **86**, 1200; **87**, 1300, 1301, 1303.

In 1896, Maj. Rossell estimated that it would cost $1,750,000 to construct 8 locks and dams between Daniels Creek and the Mulberry and Locust forks, **96**, 1462.

**Surveys.**

Ordered by act of March 3, 1879, made under direction of Maj. Damrell, 1879, **81**, 1218.

Survey of the river from Tuscaloosa to the Mulberry and Locust Forks ordered by act of Aug. 17, 1894, made in 1895 by Capt. Rossell (see *Projects*), **96**, 1463.

Minor survey made, 1899, **99**, 1702.

Maps. **96**, 1434; **1900**, 2170.

### Part E.—Tombigbee River, between Walkers Bridge and Fulton, Ala. and Miss. (See *Part A.*)

**Appropriations.**

1894, $1,000, **95**, 1698.
1896, 1,000, **96**, 1446.
1899, 1,000, **99**, 1715.

Total,[a] 3,000

**Engineers.**

Chief of Engineers. Reports, **93**, 232; **94**, 214; **95**, 239; **96**, 210; **97**, 268; **98**, 264; **99**, 308; **1900**, 350.

Engineers in Charge:

Maj. A. N. Damrell, 1875–95. Reports, **93**, 1762; **94**, 1317; **95**, 1698.

Maj. W. T. Rossell, 1896–. Reports; **96**, 1446; **97**, 1678, 1690; **98**, 1434, 1440, **99**, 1715; **1900**, 2207.

**Operations.**

**1892–93.** About 3,000 obstructions removed from banks and stream, **93**, 1762.

**1893–94.** About 2,000 obstructions removed, **94**, 1318.

**1896–97.** About 1,500 obstructions removed, **97**, 1690.

**1898–99.** About 1,800 snags and other obstructions removed from the channel and the banks of the river, **99**, 1715.

**1899–1900.** 152 snags and other obstructions removed from the channel, **1900**, 2207.

**Projects.**

Maj. Damrell, 1893, estimated that it would cost $2,500 annually for maintenance, **93**, 1762.

### Part F.—Tombigbee River, below Demopolis, Ala. and Miss. (See *Part A.*)

**Appropriations.**

1894, $75,000, **95**, 1694.
1896, 75,000, **96**, 1437.
1899, 50,000, **99**, 1712.

Total,[b] 200,000

**Commerce.**

Description of; a large commerce in timber products, cotton, and general merchandise, **96**, 1442.

**Engineers.**

Chief of Engineers. Reports, **93**,

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[a] See footnote *n*, appropriations, Part A.

[b] See also footnotes, appropriation, Part A.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part F.—Tombigbee River, below Demopolis, Ala. and Miss.—C't'd.

230; **94**, 212; **95**, 237; **96**, 209; **97**, 266; **98**, 262; **99**, 306; **1900**, 347.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1893–95. Reports, **93**, 1758; **94**, 1313; **95**, 1694.

Maj. W. T. Rossell, 1896– . Reports, **96**, 1437; **97**, 1678, 1685; **98**, 1434, 1436; **99**, 1711; **1900**, 2202.

ASSISTANT. T. W. Nichol. Report, **97**, 1439.

**Operations.**

**1892–93.** Over 900 obstructions removed, 841 piles cut for jetties, and about 1,770 c. y. dredged, **93**, 1758.

**1893–94.** About 1,100 obstructions removed, 631 l. f. old jetties repaired, 257 l. f. shore protection constructed, and 19,142 c. y. dredged, **94**, 1314.

**1894–95.** Over 7,000 obstructions removed, 16,659 c. y. dredged, and 1,294 l. f. old jetties repaired, **95**, 1695.

**1895–96.** Work commenced on lock and dam No. 1, about 2,600 obstructions removed, 11,708 c. y. dredged, and 585 trees trimmed, **96**, 1438.

**1896–97.** Work on lock No. 1 continued, over 3,000 obstructions removed, and 8,178 c. y. dredged, **97**, 1686.

**1897–98.** 1,368 obstructions removed, 2,218 c. y. excavated and removed, and work continued on lock No. 1, **98**, 1437.

**1898–99.** 155 c. y. rock, 128 snags, and other obstructions removed from channel, and borings made for lock sites, **99**, 1711.

**1899–1900.** Construction of locks at McGrews Shoals in progress, **1900**, 2203.

**Physical characteristics.**

Description of, **96**, 1439.

**Projects.**

Maj. Damrell, 1895, estimated that it would cost about $10,000 annually for maintenance, **95**, 1695.

**Surveys.**

Examination for sites of locks and dams, made in 1892 by Maj. Damrell, **93**, 1758.

MAPS. **96**, 1442.

### Part G.—Tombigbee River, between Demopolis and Columbus, Ala. and Miss. (See *Part A.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1894, | $50,000, | **95**, | 1696. |
| 1896, | 50,000, | **96**, | 1443. |
| 1899, | 10,000, | **99**, | 1713. |
| Total,[a] | 110,000 | | |

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 231; **94**, 213; **95**, 238; **96**, 209; **97**, 267; **98**, 263; **99**, 307; **1900**, 349.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1893–95. Reports, **93**, 1759; **94**, 1315; **95**, 1695.

Maj. W. T. Rossell, 1896– . Reports, **96**, 1443; **97**, 1678, 1687; **98**, 1434, 1438; **99**, 1712; **1900**, 2205.

**Operations.**

**1892–93.** About 19,000 obstructions removed, **93**, 1760.

**1893–94.** About 6,000 obstructions removed and 520 l. f. jetties repaired, **94**, 1315.

**1894–95.** Continuation of work of previous year, **95**, 1696.

**1895–96.** About 17,000 obstructions removed, 10 c. y. rock excavated and removed, and 300 l. f. jetties repaired, **96**, 1444.

**1896–97.** Over 8,000 obstructions removed, 418 l. f. jetties repaired, and jetty work in progress, **97**, 1688.

**1897–98.** About 5,000 obstructions removed, 90 l. f. old jetties repaired, 1,507 c. y. gravel, sand, and clay excavated, and jetty work in progress, **98**, 1438.

**1898–99.** 2,125 c. y. rock, about 31,000 snags and other obstructions removed from channel, and jetties repaired, **99**, 1713.

**1899–1900.** Over 1,000 c. y. gravel, clay, and sand, and about 19,000 snags and other obstructions removed from channel, **1900**, 2205.

**Projects.**

In 1893, Maj. Damrell estimated that it would cost $10,000 yearly for maintenance, **93**, 1760.

[a] See footnotes, appropriations, Part A.

## BLACK WARRIOR, WARRIOR, AND TOMBIGBEE RIVERS, ALA. AND MISS.—Continued.

### Part H.—Tombigbee River, between Fulton and Columbus. Ala. and Miss.

**Appropriations.**

1894, $4,000, **95**, 1697.
1896, 8,000, **96**, 1445.
1899, 5,000, **99**, 1714.

Total, [a]17,000

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 231; **94**, 213; **95**, 238; **96**, 210; **97**, 268; **98**, 264; **99**, 308; **1900**, 349.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1893–95. Reports, **93**, 1760; **94**, 1316; **95**, 1697.

Maj. W. T. Rossell, 1896– . Reports, **96**, 1445; **97**, 1678, 1689; **98**, 1434, 1439; **99**, 1714; **1900**, 2206.

**Operations.**

**1892–93.** About 7,500 obstructions removed, **93**, 1761.

**1893–94.** Over 3,000 obstructions removed, **94**, 1316.

**1895–96.** A few obstructions removed, 1,080 c. y. gravel and clay, 291 fascines and 90 piles used in closing a slough, a small bridge for construction purposes was built, and 180 l. f. old jetties were repaired, **96**, 1446.

**1896–97.** Over 1,100 obstructions were removed, **97**, 1689.

**1897–98.** Over 10 obstructions were removed, 284 l. f. shore protected, and 36 c. y. rock excavated, **98**, 1439.

**1899–1900.** About 6,300 snags and other obstructions removed from the river, and banks protected, **1900**, 2206.

**Projects.**

Maj. Damrell, 1893, estimated that it would cost $5,000 annually for maintenance, **93**, 1761.

## BLACK WARRIOR RIVER, ALA. (Operating and care of locks and dams.)

**Appropriations.**[b]

1897, $5,564.43
1898, 4,782.01
1899, 5,428.92
1900, 8,505.24

Total, 24,280.60

**Engineers.**

CHIEF OF ENGINEERS. Reports, **97**, 265; **98**, 261; **99**, 305; **1900**, 346.

ENGINEER IN CHARGE. Maj. W. T. Rossell, 1897—. Reports, **97**, 1675; **98**, 1431; **99**, 1703; **1900**, 2171.

**Operations.**

**1896–97.** A lock master, 3 lock hands, and 3 assistant lock hands were appointed July 1, 1896, **97**, 1675. Pool above lock No. 3, 7 miles long, was lowered 5½ f. for a few days, on petition of mine owners and others interested, to allow certain repairs to be made. Repairs were made to house, etc., at lock No. 1, and to dams Nos. 1, 2, and 3, **97**, 1675, 1676. 1,227 lockages were made, **97**, 1677.

**1897–98.** Filling above dams to reduce leakage, and repairs were made to lock Nos. 1 and to shore protection, **98**, 1432. Over 2,000 lockages were made, **98**, 1433.

**1898–99.** Fences, inclosing U. S. land, were built at locks Nos. 1 and 3; at lock No. 1, leak repaired, and 6 new steel balanced gate valves built, **99**, 1704.

**1899–1900.** Repairs made to locks Nos. 1, 2, and 3, and a total of 408 c. y. flood deposit and 11 barge loads of logs removed from the three locks, **1900**, 2174.

**Physical characteristics.**

On Apr. 16–17, 1899, arose the highest and most violent flood ever known in this region, the rainfall being 8.40 inches at Tuscaloosa in a continuous rain lasting about 32 hours, **1900**, 2172.

## BLACK WARRIOR RIVER AND FIVE-MILE CREEK, ALA. (Canal, via Valley Creek, to connect.)

**Commerce.**

Description of, **97**, 1705; **99**, 1749.

In 1896 it seemed safe to assume that there would be heavy shipments by the proposed canal if it were built and thrown open to traffic by the Government, **97**, 1705.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **97**, 275; **98**, 269; **99**, 317.

ENGINEERS IN CHARGE. Maj. W. T. Rossell, 1897–99. Reports, **97**, 1704; **98**, 1446; **99**, 1730.

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[a] See footnotes, appropriations, Part A.

[b] Expenditure under the permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## BLACK WARRIOR RIVER AND FIVE-MILE CREEK, ALA. (Canal, via Valley Creek, to Connect)—Continued.

Assistants:
J. Ripley. Report, **99**, 1735.
O. W. Ferguson. Report, **99**, 1765.

**Physical characteristics.**
Description of, **97**, 1705, 1706; **99**, 1735.

**Projects.**
Maj. Rossell estimated, 1898, it would cost either $4,000,000 or $4,500,000 for the improvement desired, **99**, 1731.

**Surveys.**
Examination ordered by act of June 3, 1896, made by Maj. Rossell, 1896, (survey recommended), **97**, 1705.
Survey for a canal between Black Warrior River and Five-Mile Creek ordered by act of June 4, 1897, made, 1898, under direction of Maj. Rossell (see *Projects*), **99**, 1731.
Bench marks, **99**, 1761; 1770.

## BLACKWATER RIVER AND EAST BAY, ALA. AND FLA.

**Appropriation.**
1899, $5,000, **99**, 1673.

**Commerce.**
Benefit of improvement, **82**, 1312.

**Engineers.**
Chief of Engineers. Reports, **80**, 141; **81**, 189; **82**, 185; **99**, 297; **1900**, 338.
Engineers in Charge:
Capt. A. N. Damrell, 1882. Report, **82**, 1309.
Capt. C. A. F. Flagler, 1899—. Reports, **99**, 1673; **1900**, 2126.
Assistant: H. Haines. Report, **82**, 1311.

**Operations.**
**1899–1900.** 12,559 c. y. dredged, **1900**, 2128.

**Physical characteristics.**
Description of, **99**, 1673.

**Projects.**
By Capt. Damrell, 1882, for a 9-f. channel, m. l. w., 100 f. wide, estimated cost $20,000, **82**, 1310; **99**, 1673; **1900**, 2127.

**Surveys.**
Ordered by act of Mar. 3, 1879, **80**, 141; made, 1880, under direction of Capt. Damrell, **82**, 1309.
Minor surveys, **1900**, 2127, 2128.

## BLACKWATER RIVER, VA.

**Appropriations.**
1878, $5,000, **78**, 74.
1879, 2,500, **79**, 90.
1880, 3,500, **80**, 822.
1881, 1,500, **81**, 992.
1882, 1,500, **82**, 1077.

Total, 14,000

**Commerce.**
Commercial advantages of tributary country, **75**, ii, 161.

**Engineers.**
Chief of Engineers. Reports, **75**, 95; **78**, 73; **79**, 90; **80**, 119; **81**, 160; **82**, 156; **83**, 162; **84**, 165; **85**, 157; **86**, 152; **87**, 120.
Engineers in Charge:
S. T. Abert, U. S. C. E., 1875–79. Reports, **75**, ii, 161; **78**, 522; **79**, 620.
Capt. C. B. Phillips, 1879–81. Reports, **79**, 682; **80**, 821.
Capt. J. Mercur, 1881–84. Reports, **81**, 991; **82**, 1077; **83**, 843.
Capt. F. A. Hinman, 1884–87. Reports, **84**, 1031; **85**, 1033; **86**, 961; **87**, 987.
Col. W. P. Craighill, 1888. Report, **88**, 772.
Assistants: G. H. Elliott, W. H. Powless, and C. A. Turrill, 1874–75, **75**, ii, 162.

**Obstructions.**
Bars of deposited sawdust, **75**, ii, 162.

**Operations.**
**1878–79.** 1,223 snags, logs, and fallen trees and 144 overhanging trees removed with hired labor, **79**, 90, 621, 683.
**1879–80.** Removal of wreck, 161 snags, and 205 trees; also 54,110 c. y. dredged from bar at mouth and Georges Bend, **80**, 822.
**1880–81.** 18,000 c. y. dredged at Franklin and Littletown Bend, and 90 l. f. of revetment built at Franklin, **81**, 992.
**1882–83.** Dredging at Littletown Bend, **83**, 843.
**1883–84.** Removing 515 snags, logs, and trees, **84**, 1031.

**Physical characteristics.**
General, **75**, ii, 161; **79**, 620. Obstructions: Snags, piles, trees, and crooked bends, **75**, ii, 161; **78**, 522; **79**, 620.

**Projects.**
By S. T. Abert, U. S. C. E., 1875, for dredging and removing snags and trees, mouth to Franklin. Estimated cost, $14,850. **75**, ii, 162; **78**, 74; **87**, 120.

**Surveys.**
Under direction of S. T. Abert, U. S. C. E., 1874–75. Report, **75**, ii, 161.

## BLO BUCK POINT PASS, TEX.

**Appropriation.**
1872, $1,000, **73**, 676 (survey).

**Commerce.**
Unimportant, **73**, 676.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **72**, 62; **73**, 66.

ENGINEER IN CHARGE: Capt. C. W. Howell, 1872. Report, **73**, 676.

ASSISTANT: Lt. H. M. Adams, 1872. Report, **73**, 676.

**Survey.**
Examination by Lt. Adams, 1872. Report **73**, 676.

## BLOCK ISLAND. (See *Great Salt Pond, R. I.*)

## BLOCK ISLAND, R. I., Harbor of Refuge at.

**Appropriations.**

| | | |
|---|---|---|
| 1870, | $30,000, | **70**, 75. |
| 1871, | 75,000, | **71**, 84. |
| 1872, | 50,000, | **72**, 81. |
| 1873, | 50,000, | **73**, 89. |
| 1874, | 20,000, | **74**, 100. |
| 1875, | 20,000, | **75**, 109. |
| 1876, | 40,000, | **76**, 50; **77**, 44. |
| 1880, | 6,000, | **80**, 390. |
| 1882, | 19,000, | **82**, 562. |
| 1884, | 15,000, | **84**, 628. |
| 1886, | 20,000, | **86**, 612. |
| 1888, | 15,000, | **88**, 507. |
| 1890, | 15,000, | **90**, 578. |
| 1892, | 24,000, | **92**, 632. |
| 1894, | 2,500, | **95**, 695. |
| 1896, | 5,000, | **96**, 659. |
| 1899, | 10,000, | **99**, 1140. |
| Total, | 416,500 | |

**Commerce.**
Important, **67**, 45, 451; **68**, 749, 785, 788 et seq.; **72**, 978; **74**, ii, 241; **78**, 242; **79**, 312.
Increase of commerce, **82**, 85.
Value of harbor, **85**, 611.

**Contracts.**
**1870.** John Beattie, stone for substructure, **70**, 451.
**1871.** Finch, Engs & Co., lumber and cement. R. S. Place & Co., bolts. C. C. Campbell, granite. **71**, 741.
**1872.** J. G. Sheffield, granite, **72**, 822.
**1873.** F. H. Smith, granite, **73**, 977.
**1874.** F. H. Smith, granite, **75**, ii, 293.
**1877.** P. Harrington & Co., granite, **77**, 201.
**1878.** F. H. Smith, granite, **78**, 243.
**1880.** McDermott & Daly, dredging, 28 cents per c. y., **81**, 563.
**1883.** C. H. Edwards, granite riprap, $1.89 per ton, **83**, 496. J. Scully, building harbor wall, **83**, 496.
**1884.** J. Scully, depositing riprap in breakwater gap, $1.65 per t., **85**, 608.
**1887.** W. H. Molthrop & Co., granite riprap for breakwater and enlargement of inner harbor, **87**, 560.
**1893.** W. H. Molthrop & Co., fender piers, $750; stone, $2.10 per t. ($14,000), **93**, 844.
**1895.** Hardford Dredging Co., dredging, 33⅓ cents per c. y., s. m. ($1,000), **95**, 694.
**1896.** T. A. Scott, dredging, 30 cents per c. y. ($800), **96**, 658.
**1897.** T. A. Scott, dredging, 35 cents per c. y. ($1,750), **97**, 924.
**1899.** J. Beattie, stone, $2.25 per s. t., **1900**, 1275.
**1900.** Cole Bros., dredging, 32 cents per c. y., **1900**, 1275.

**Defense.**
Discussion of feasibility of protecting harbor by means of earthworks, **68**, 790, 796.

**Documents.**
S. Doc. 81, 40th Cong., 2d sess. Report of Board of Engineers of 1868, **70**, 451; **71**, 741; **77**, 201.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **67**, 17, 18, 45; **68**, 67; **70**, 75; **71**, 84; **72**, 81; **73**, 89; **74**, 99; **75**, 109; **76**, 50; **77**, 44; **78**, 48; **79**, 55; **80**, 75; **81**, 85; **82**, 85; **83**, 82; **84**, 88; **85**, 76; **86**, 77; **87**, 40; **88**, 41; **89**, 52; **90**, 47; **91**, 59; **92**, 63; **93**, 66; **94**, 59; **95**, 66; **96**, 66, 71; **97**, 78; **98**, 82; **99**, 94; **1900**, 108.

BOARD OF ENGINEERS:
Col. H. Bache, president. Convened Feb. 18, 1868. Three plans for breakwaters were proposed, one for a harbor large enough to shelter vessels of the largest class, and the other two for a harbor for local purposes. The board adopted the plan for a breakwater on a line extending 500 f. from a point near Sands Landing to Five-foot Rock, for local purposes. **70**, 75, 451; **75**, ii, 294; **77**, 201.

ENGINEERS IN CHARGE:
Maj. D. C. Houston, 1867–70, **67**, 18. Reports, **67**, 451; **68**, 749, 785.
Lt. Col. G. K. Warren, 1870–82, **70**, 74. Reports, **70**, 451; **71**, 739; **72**, 821; **73**, 977; **74**, ii, 240; **75**, ii, 292; **76**,

**BLOCK ISLAND, R. I., Harbor of Refuge at**—Continued.

209; **77**, 201; **78**, 241; **79**, 311; **80**, 390; **81**, 563; **82**, 562.

Lt. Col. G. H. Elliot, 1882–87. Reports, **83**, 496; **84**, 626; **85**, 606, 610; **86**, 609.

Maj. W. R. Livermore, 1887–92. Reports, **87**, 558; **88**, 504; **89**, 631; **90**, 557; **91**, 723.

Capt. W. H. Bixby, 1892–95. Reports, **92**, 630; **93**, 842; **94**, 597; **95**, 693.

Maj. D. W. Lockwood, 1896—. Reports, **96**, 657, 673; **97**, 922; **98**, 926; **99**, 1139; **1900**, 1272.

ASSISTANTS:

G. W. Dresser, **67**, 451. Reports, **67**, 454; **68**, 788.

J. P. Cotton. Reports, **72**, 823; **73**, 977; **74**, ii, 241; **80**, 391.

**Obstructions.**

To commerce, **68**, 795. List of vessels wrecked off Block Island, **68**, 802.

**Operations.**

**1870–71.** Breakwater extension, 500 l. f., **71**, 739.

**1871–72.** Jetty extension, 270 l. f.; crib work commenced, **72**, 821, 823, 824.

**1872–73.** Jetty extension, 80 l. f.; cribs finished; dredging and rock excavation from inner harbor, **73**, 976, 978.

**1873–74.** Rock removed, 446 t.; breakwater extension, 330 l. f., **74**, 99, ii, 240.

**1874–75.** Rock removed, 594½ t.; bulkhead wall constructed; breakwater enlarged, **75**, 109, ii, 293.

**1875–76.** Repairs, **76**, 210.

**1876–77.** Breakwater enlarged, **77**, 201, 202.

**1877–78.** Rock removed, 517 t.; breakwater extension, 300 l. f., **78**, 48, 242.

**1878–79.** Repairs, **79**, 311, 313.

**1880–81.** Removal of wreck and dredging 16,146 c. y. from inner harbor, **81**, 563.

**1882–83.** Construction of jetty with hired labor and building harbor wall by contract, **83**, 496.

**1883–84.** Completion of sea wall and jetty; repair of wharf at inner harbor, **84**, 627.

**1884–85.** 5,795 t. riprap placed in breakwater gap, **85**, 608.

**1885–86.** 2,376 t. riprap placed in breakwater gap; repairs to piers of inner harbor, **86**, 611.

**1887–88.** Six-sevenths of the gap filled; timber jetty forming shore end of western wall completed and filled with stone; north wall commenced, **88**, 506.

**1888–89.** 3,550 t. of riprap granite placed in north wall of inner harbor, **89**, 632.

**1889–90.** 1,941 t. of riprap granite placed in north wall of inner harbor, and 420 t. on the breakwater; 3,025 c. y. sand dredged from shoal at entrance to harbor, **90**, 576.

**1890–91.** 3,711 t. of riprap granite placed in extension of north wall of enlarged inner harbor, **91**, 725.

**1891–92.** 2,381 t. of riprap granite placed in extension of north sea wall, **92**, 631.

**1892–93.** 1,044 t. stone deposited in breakwater, **93**, 843.

**1893–94.** 6,915 t. stone deposited in breakwater, 38 fender piles placed, about 5,500 c. y. dredged, and 1,013 t. of bowlders removed from old jetty and placed in the new one, **94**, 599.

**1894–95.** About 2,800 c. y. dredged, **95**, 694.

**1895–96.** About 3,300 c. y. dredged, **96**, 658.

**1896–97.** 2,258 c. y. dredged, **97**, 924.

**1897–98.** 2,742 c. y. dredged, **98**, 928.

**1899–1900.** 2,901 t. stone placed to repair breakwater and 5,500 c. y. dredged from inner harbor entrance, **1900**, 1273.

**Physical characteristics.**

General, **67**, 454; **68**, 793, 794; **90**, 375; **96**, 674.

Site described, **68**, 789; **78**, 241; **79**, 311, 312.

Tides, **68**, 796, 799; **75**, ii, 294; **79**, 311.

North wall damaged by storms, winter, 1898–99, **99**, 1140.

**Plans.**

By G. W. Dresser, for dredging channel, 2,465 f. long, 633 f. wide, and 25 f. deep; for construction of piers, 900 f. long, 20 f. wide, and 17½ f. high, $1,000,000, **68**, 741, 793. For breakwater 3,000 f. long, substructure 30 f. wide, superstructure 15 f. wide on top, 20 f. wide at base, 12 f. high; also for a light-house, $1,445,000, **68**, 795.

By Board of Engineers, 1868: (1) For a breakwater sheltering a harbor of sufficient capacity for vessels of largest class. (2) For a breakwater extending 300 f. beyond Five-foot Rock and sheltering a harbor for local purposes. Estimates, $553,798 and $3,000,000. (3) See *Projects*. **75**, ii, 294; **77**, 201, 202.

By J. P. Cotton, for jetty extension of 700 f., and pier construction, $86,000, **74**, ii, 242.

**Private (corporate) work.**

Construction of a wharf by Fall River Iron Co., **74**, ii, 240.

## BLOCK ISLAND, R. I., Harbor of Refuge at—Continued.

**Projects.**

By Board of Engineers, 1868, for breakwater extending from the shore to Five-foot Rock, faced with cut stone, estimated cost, $372,000; subsequently modified so as to dispense with this facing; ultimately extended to a point 500 f. beyond Five-foot Rock, **70**, 452; **75**, ii, 294; **77**, 202.

By Lt. Col. Warren, for construction of temporary harbor to consist of 2 cribs, with wings approaching each other, leaving an opening of 60 f., **71**, 839; **72**, 823; **79**, 311. For a detached breakwater 300 f. long, to protect harbor from northeast winds, estimated cost, $60,000, **74**, ii, 242, 243.

By Lt. Col. Warren, 1880, for dredging the inner harbor to a depth of 9 f., with the removal of a wreck therefrom; estimated cost, $8,000, **80**, 391, 392; completed, 1881, **81**, 563.

By Lt. Col. Warren, 1881, for the construction of a harbor wall on the east side of the inner harbor and the construction of a jetty to protect the harbor from material washed from the southwest and eastward; estimated cost, $19,000, **82**, 563.

The project under which work was being carried on in 1888 was a consolidation of four prior projects, namely, one by Lt. Col. Elliot, 1883, for replacing the timber cribs on north and west sides of the inner harbor by walls of stone and for replacing south wharf by a retaining wall backed by earth, estimated cost, $30,000, **83**, 497; another project by Lt. Col. Elliot in 1884, for closing a gap 200 f. long in the main breakwater, estimated cost, $30,000, **84**, 628; another by Lt. Col. Elliot, 1885, for the enlargement of the inner harbor to an area of about 18¾ acres, estimated cost, $46,189, **86**, 611, 613; and lastly a project by Maj. Livermore, 1888, for removal of a shoal obstructing navigation at the entrance to Block Island Harbor, giving a depth of 9 f. to a line 20 f. from the breakwater; estimated cost, $5,000, **88**, 505, 506; total estimated cost of project, $111,189. These combined projects provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 f. in area and inclosed save for an opening 80 f. in width. The exterior harbor was to be formed by a riprap breakwater 1,000 f. in length. **91**, 724; **92**, 631.

By Maj. Lockwood, 1895, for raising the height of the breakwater, stopping sand leaks at certain points, and dredging in the main harbor to depth of 10 feet, estimated cost, $83,985, **96**, 658.

By Capt. Bixby, 1895, for dredging and all other work to be done with hired labor and the Government plant, **95**, 694.

By Maj. Lockwood, 1899, for repairing and strengthening north wall of the inclosed harbor, **99**, 1140.

**Surveys.**

By G. W. Dresser, 1867-68, **67**, 45; **68**, 749. Reports, **67**, 454; **68**, 788.

Survey ordered by act of Aug. 17, 1894, made by Maj. Lockwood, 1895 (see *Projects*), **96**, 673.

MAPS:

**80**, 390; **85**, 612; **88**, 506, soundings; **93**, 844; **95**, 694.

## BLOOD RIVER, LA. (See *Tickfaw River*.)

## BLOSSOM ROCK. (See *San Francisco, Cal.*)

## BLUE BUCK BAR AND POINT, TEX. (See *Sabine Pass, Tex.*)

## BLUE HILL HARBOR, ME.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 32.

ENGINEER IN CHARGE. Lt. Col. J. A. Smith, 1891. Report, **91**, 611.

**Physical characteristics.**

Description of, **91**, 611.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Smith (report unfavorable), **91**, 611.

## BLUE RIVER. (See *Red River, Ark., La., and Tex.*)

## BLUFF CREEK, MISS.

**Appropriation.**

1890, $1,000, **91**, 1792.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 193; **91**, 218; **92**, 211; **93**, 234.

ENGINEER IN CHARGE. Maj. A. N. Damrell, 1888-93. Reports, **89**, 1461; **91**, 1792; **92**, 1457; **93**, 1770.

**Operations.**

**1891-92.** 482 stumps and snags removed from the channel, and 4,000 over-

## BLUFF CREEK, MISS.—Continued.

hanging trees cleared from the banks, **92**, 1457.

**1892–93.** About 4,500 obstructions removed from banks and stream, **93**, 1770.

**Projects.**

By Maj. Damrell, 1889, removal of snags, logs, and leaning trees, at an estimated cost of $1,000, **89**, 1461. Project completed in 1892, **92**, 1457.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Damrell, **89**, 1461.

## BOCA CIEGA BAY, FLA. (See *Clearwater Harbor.*)

## BODEGA BAY, CAL. (See also *Pacific Coast, Harbor of refuge.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **77**, 123.

BOARD OF ENGINEERS:

Of the Pacific coast, met Aug. 1876, to examine the harbors of Mendocino, Humboldt Bay, Trinidad, Crescent City, Cal., with a view of establishing a breakwater and harbor of refuge. The board did not consider Bodega Bay, Cal., well adapted for that purpose on account of the frequent fogs. Report, **77**, 1051.

(Lt. Cols. R. S. Williamson, B. S. Alexander, C. S. Stewart, and Maj. G. H. Mendell.)

**Estimates.**

By Board of Engineers, breakwater, $6,414,300, **77**, 1058.

## BŒUF BAYOU (RIVER), LA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1881, | $5,000, | **81**, | 1423. |
| 1882, | 5,000, | **82**, | 1560. |
| 1884, | 5,000, | **84**, | 1331. |
| 1886, | 5,000, | **86**, | 1354. |
| 1888, | 6,000, | **88**, | 1354. |
| 1890, | 5,000, | **90**, | 1887. |
| 1892, | 10,000, | **92**, | 1616. |
| 1894, | 8,000, | **95**, | 1922. |
| 1896. | 6,000, | **96**, | 1608. |
| 1899, | 6,000, | **99**, | 2005. |

Total, 61,000

**Commerce.**

Important, **81**, 1427; **85**, 1546.

Description of, **95**, 1971, 1972; **96**, 1609.

The average annual commerce for the last eleven years, 6,856, tons, valued at $297,000, **1900**, 406.

**Contracts.**

**1885.** Emmick & Feith, removal of obstructions, $75 per mile, **85**, 1503.

**1888.** A. Hefner, earth filling, 22 cents per c. y., **88**, 1353.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 158; **81**, 213; **82**, 209; **83**, 218; **84**, 222; **85**, 235, 244; **86**, 231; **87**, 196; **88**, 179; **89**, 211; **90**, 190; **91**, 241; **92**, 233; **93**, 263; **94**, 243; **95**, 272, 279; **96**, 237; **97**, 303; **98**, 294; **99**, 353; **1900**, 405.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1880–82. Report, **81**, 1423.

Capt. C. A. Miller, 1882–84. Reports, **82**, 1560; **83**, 1161; **84**, 1331.

Capt. E. Bergland, 1884–86. Reports, **85**, 1502; **86**, 1354.

Capt. J. N. Willard, 1886–99. Reports, **87**, 1461; **88**, 1353; **89**, 1603; **90**, 1885; **91**, 1985; **92**, 1614; **93**, 2015; **94**, 1475; **95**, 1920, 1969; (Maj.) **96**, 1605; **97**, 1917; **98**, 1614; **99**, 2002.

Maj. T. L. Casey, 1900. Report, **1900**, 2515.

ASSISTANTS:

H. St. Coppée. Report, **81**, 1424.
C. Quinn. Report, **85**, 1546.
J. Ewens. Report, **91**, 1986.
T. C. Thomas. Report, **96**, 1608.

**Operations.**

**1881–82.** By hired labor, 3,264 logs, trees, and stumps removed, and 3 brush heaps destroyed, **82**, 1560.

**1882–83.** By hired labor, 2,663 logs and trees and 3 brush heaps removed, **83**, 1161.

**1884–85.** By contract, 1,679 logs, snags, and trees and 35 brush heaps removed, **85**, 1503.

**1887–88.** Closure of outlet No. 1 completed, **88**, 1353.

**1888–89.** Closure of outlets Nos. 2 and 3 completed by deposit of 14,860 c. y. of earth; 3,000 snags removed from channel, and 7,440 trees and 3,770 s. y. brush cleared from the banks, **89**, 1603.

**1889–90.** 130 snags removed from the channel, and 314 trees and shore snags cleared from the banks, **90**, 1886.

**1891–92.** 40,416 snags, logs, and stumps cleared from the channel; 11,156 shore snags removed; 66,557 leaning trees removed or girdled; 20,060 s. y. brush and willows cut; wreck removed, **92**, 1616,

## BŒUF BAYOU (RIVER), LA.—Continued.

**1893–94.** 23,000 snags and other obstructions removed and 2,050 s. y. brush and willows cut, **94**, 1478.

**1894–95.** 1,830 l. f. brush dams built; 48,021 s. y. brush and willows cut, and about 12,000 snags, etc., removed, **95**, 1922.

**1895–96.** 13,414 s. y. brush, etc., cut; over 20,000 snags, etc., removed. Project for high-water navigation completed, **96**, 1607.

**1896–97.** A few obstructions removed, **97**, 1919.

**1898–99.** About 4,600 snags and other obstructions and 21,996 s. y. willows and brush removed from channel and banks of the river, **99**, 2003.

**Physical characteristics.**

River described, **81**, 1425; **93**, 2016; **94**, 1477; **95**, 1922, 1969; **96**, 1608.

The river rises in southern Arkansas and enters the Ouachita in Louisiana. The part examined, 1895, consists of a succession of pools and shoals, dry or nearly so at the lowest stages, and almost impassable because of snags and other obstructions, **95**, 1973.

Channel depths increasing below mouths of outlets near Point Jefferson, **96**, 1607; cross sections at, **96**, 1610.

Table showing low-water depths over the upper shoals and bars, **96**, 1608.

**Projects.**

By Maj. Benyaurd, 1880, for improvement from Wallace to the mouth, 280 miles, by removal of obstructions; estimated cost, $20,020, **81**, 1424, 1428.

By Capt. Bergland, 1884, for closing 3 outlets of Bœuf River near Point Jefferson; estimated cost, $8,500, **85**, 235, 1503, 1546.

In 1892 $26,000 was estimated as required to complete the closure of the three outlets, for continuing the removal of obstructions, and for survey of Bœuf River, **92**, 1616.

In 1893 Capt. Willard estimated it would cost $30,000 to close the three outlets near Point Jefferson destroyed by levee breaks of 1890, **93**, 2017; **96**, 1607.

In 1896 Maj. Willard estimated it would require $2,500 yearly to maintain improvement made by completed project of that year, **96**, 1607.

By Maj. Willard, 1896, to defer expending of appropriation of 1896 until sufficient money should be on hand to close outlets near Point Jefferson, **97**, 1917.

Maj. Willard estimated, 1899, it would cost $30,000 to close the outlets, and $2,500 for maintenance, **99**, 2004.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 158; made under direction of Maj. Benyaurd, 1880, **81**, 1423.

Of outlets of Bœuf River, ordered by act of July 5, 1884, made under direction of Capt. Bergland, 1884, **85**, 1545.

The three outlets near Point Jefferson and the old connecting levees between them examined, 1893, under direction of Capt. Willard, **93**, 2016.

Examination of the river in Arkansas above Wallaces Landing ordered by act of Aug. 17, 1894; report submitted, 1895, by Capt. Willard (report unfavorable), **95**, 1969.

Reconnoissance made, 1896, under direction of Maj. Willard, **96**, 1607.

## BOGGS BAY, VA. (See *Franklin City.*)

## BOGUE CHITTO. (See *Chitta Bayou, La.*)

## BOGUE CHITO RIVER, LA. AND MISS.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 197; **83**, 212.

ENGINEER IN CHARGE. Maj. A. Stickney, 1883. Report, **83**, 1133.

ASSISTANT. H. C. Collins. Report, **83**, 1133.

**Survey.**

Ordered by act of June 14, 1880, **80**, 146; made under direction of Maj. Stickney (report unfavorable, cost too great), **83**, 1133.

## BOGUE FALIA. (See *Chefuncte River, La.*)

## BOGUE INLET, N. C.

**Commerce.**

Description of. The desired improvement in 1896 would be a benefit apparently to only two firms and for a short time only. **97**, 1419.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 211.

ENGINEERS IN CHARGE:

Lt. Col. Heap, 1896–97. Reports, **97**, 1418, 1421.

## BOGUE INLET, N. C.—Continued.

Capt. W. E. Craighill, 1897. Reports, **97**, 1418, 1421.

Assistants.

Lt. E. Jadwin. Report, **97**, 1419.

W. H. Chadbourn, jr. Report, **97**, 1422.

**Physical characteristics.**

Description of. The locality is at the first inlet south of Beaufort Inlet, 25 miles distant. **97**, 1419.

**Projects.**

In 1897, Lt. Col. Heap estimated that the construction of a jetty to remove the sand bar at the inlet would cost $16,818.75, **97**, 1421.

**Surveys.**

Examination for a jetty and a survey at the discretion of the Secretary of War for the preparation of an estimate of cost of constructing a jetty, ordered by act of Aug. 3, 1896, made under the direction of Lt. Col. Heap (report unfavorable) (see *Projects*), **97**, 1418.

## BOGUE PHALIA, MISS. (See *Big Sunflower River.*)

**Commerce.**

Description of. Unimportant. **89**, 1629; **95**, 1990.

**Engineers.**

Chief of Engineers. Reports, **89**, 217; **95**, 280.

Engineer in Charge. Capt. J. H. Willard, 1889–95. Reports, **89**, 1628; **95**, 1988.

Assistant. D. M. Marshall. Report, **89**, 1628.

**Physical characteristics.**

Description of. A very crooked stream, tributary to the Big Sunflower, obstructed by logs, jams, etc. **89**, 1629; **95**, 1988.

**Surveys.**

Examination, especially of the Narrows, ordered by act of Aug. 11, 1888, made under the direction of Capt. Willard in 1889 (report unfavorable), **89**, 1628. Another examination, ordered by act of Aug. 17, 1894, made by Capt. Willard, 1895 (report unfavorable), **95**, 1988.

## BOGUE SOUND, N. C., New River to Beaufort. (See *Beaufort and New River, N. C.*, and *New River-Swansboro waterway.*)

## BOLIVAR CHANNEL. (See *Galveston Bay Ship Channel.*)

## BONFUCA BAYOU, ST. TAMMANY PARISH, LA.

**Commerce.**

Description of, **95**, 1783.

**Engineers.**

Chief of Engineers. Report, **95**, 260.

Engineer in Charge. Maj. J. B. Quinn, 1894–95. Report, **95**, 1783.

**Physical characteristics.**

Description of. Bayou flows into Lake Pontchartrain with a depth of about 20 f. for a distance of nearly 15 miles from its mouth. **95**, 1783.

**Survey.**

Examination ordered by act of Aug. 17, 1894, made, 1895, by Maj. Quinn (report favorable), **95**, 1783.

## BON SECOUR. (See *Gulf of Mexico, waterway.*)

## BON SECOUR BAY. (See *Pensacola Bay, Fla.*)

## BOONE FORK, KY. (See *Kentucky River.*)

## BOONVILLE, MO. (See *Missouri River between mouth and Sioux City.*)

## BOOTHBAY HARBOR, ME.

**Commerce.**

Important, **97**, 803; **1900**, 1119.

**Engineers.**

Chief of Engineers. Reports, **97**, 43; **99**, 62; **1900**, 63.

Engineers in Charge:

Maj. R. L. Hoxie, 1897. Report, **97**, 802.

Maj. S. W. Roessler, 1900. Report, **1900**, 1117, 1120.

## BOOTHBAY HARBOR, ME.—Continued.

ASSISTANT. A. C. Both. Report, **1900**, 1118.

**Physical characteristics.**

Description of, **97**, 803; **1900**, 1119, 1120.

Harbor so well favored naturally as to require no artificial works, 1899, **1900**, 1121.

**Surveys.**

Examination ordered by act of June 3, 1896, made by Lt. Col. Damrell, 1897 (report favorable), **97**, 803.

Examination and survey ordered by act of Mar. 3, 1899, made under direction of Maj. Roessler, 1899 (see *Physical characteristics*), **1900**, 1117, 1120.

## BOSTON HARBOR, MASS.[a] (See *Charles River; Chelsea River; East Boston Harbor; Hull, Mass.; Narragansett Bay, canal to.*)

**Appropriations.**[b]

| | | |
|---|---|---|
| 1825,[c] | $52,972.56, | act Mar. 2. |
| 1828,[c] | 2,000.00, | act Mar. 19. |
| 1828, | 87,000.00, | act May 23. |
| 1829,[c] | 7,310.54, | act Mar. 2. |
| 1831,[c] | 5,000.00, | act Mar. 2. |
| 1831, | 12,390.00, | act Mar. 2. |
| 1832,[c] | 9,000.00, | act Feb. 24. |
| 1832, | 60,000.00, | act July 3. |
| 1836, | 15,000.00, | act July 4. |
| 1838, | 7,353.00, | act July 7. |
| 1841, | 1,000.00, | act Mar. 3. |
| 1841,[c] | 1,500.00, | act Mar. 3. |
| 1842,[c] | 2,000.00, | act Aug. 31. |
| 1843,[c] | 16,000.00, | act Mar. 3. |
| 1848,[c] | 40,000.00, | act July 20. |
| 1852, | 30,000.00, | act Aug. 30. |
| 1864, | 40,000.00, | act July 2. |
| 1864,[c] | 10,000.00, | act July 2. |
| 1865,[c] | 3,000.00, | act Feb. 28. |
| 1865, | 20,000.00, | act Feb. 28. |
| 1866, | 50,000.00, | act June 12. |
| 1866,[c] | 75,000.00, | act July 12. |
| 1867, | 375,000.00, | **71**, 886. |
| 1868, | 43,000.00, | **68**, 25 (allotment). |
| 1869, | 82,170.00, | **69**, 22 (allotment). |
| 1869, | 24,750.00, | **69**, 23 (allotment). |
| 1870, | 100,000.00, | **70**, 78; **71**, 94. |
| 1871, | 100,000.00, | **71**, 94. |
| 1872, | 75,000.00, | **76**, 168. |
| 1873, | 150,000.00, | **73**, 104. |
| 1874,[d] | 100,000.00, | **74**, 114. |
| 1875, | 90,000.00, | **75**, 119. |
| 1876, | 50,000.00, | **76**, 46. |
| 1878, | 55,000.00, | **78**, 44. |
| 1879, | 50,000.00, | **79**, 50. |
| 1880,[e] | 75,000.00, | **80**, 346. |
| 1881,[f] | 100,000.00, | **81**, 515. |
| 1882, | 96,500.00, | **82**, 513. |
| 1884, | 5,000.00, | **84**, 513. |
| 1886, | 56,250.00, | **86**, 570. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1888, | 125,000.00, | **88**, 455. |
| 1890, | 145,000.00, | **90**, 505. |
| 1892, | 300,000.00, | **92**, 582. |
| 1894, | 200,000.00, | **95**, 628. |
| 1896, | 70,000.00, | **96**, 606. |
| 1897, | 400,000.00, | **97**, 845. |
| 1898, | 250,000.00, | **98**, 870. |
| 1899, | 75,000.00, | **99**, 1078. |
| 1899, | 163,751.00, | **99**, 1078. |
| 1900, | 317,000.00, | **1900**, 1201. |

Total, 4,219,947.10

**Commerce.**

Dangers to shipping from Corwin Rock, **69**, 422.

Benefits from the improvement stated by the collector of customs, **70**, 471.

Commercial interests affected by improvement of Hingham Harbor, **75**, ii, 420.

Large and increasing. The port the second greatest on the Atlantic seaboard, 1898. **98**, 889.

**Contracts.**[g]

**1868.** Albert Boschke, dredging, 50 cents, **68**, 806, 818. Charles Wooley, dredging, 75 cents (abandoned), **68**, 818. William W. Wright, dredging, 75 cents (transferred), **68**, 807, 818. George W. Townsend, blasting, **68**, 807, 811, 818. James Andrews, work and granite, **68**, 808, 818. T. W. Hoxie & Co., sand and cement, **68**, 808, 818. Franklin Mead, stone, concrete, **68**, 808, 818. Edmund Langley, sea walls, **68**, 835. Samuel R. Edwards, sea walls, **68**, 836. Derry & Edwards, sea walls, **68**, 836. James Phillips, sea walls, **68**, 839.

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[a] Boston Harbor and Narragansett Bay Canal. Examination.—Report (favorable), Feb. 3, 1825. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Appropriations to June 12, 1866, and allotment of Apr. 10, 1869, of $24,750, are for sea walls and preservation of islands.

[c] Fortification act.

[d] $10,000 not included allotted to Hingham Harbor.

[e] $22,500 at mouth of Charles River in Boston Harbor and up to Watertown, $17,500 at mouth of Mystic River, $5,000 from Boston Harbor to Nantasket Beach.

[f] $35,000 for mouth of Charles River in Boston Harbor and up to Watertown, $20,000 at mouth of Mystic River, $5,000 from Boston Harbor to Nantasket Beach.

[g] Remarks by Col. Benham on relative economy of work done by contract or by hired labor, **68**, 838.

## BOSTON HARBOR, MASS.—Continued.

**1870.** James M. Andrews, sea walls, **70**, 466. W. A. Kenrick, wharf, **70**, 465. E. R. Seward, dredging, 85 cents, **71**, 880.

**1871.** James M. Andrews, sea walls, **71**, 881. R. G. Packard, dredging, 57 cents, **71**, 880; **72**, 947.

**1872.** James Andrews, sea walls, **72**, 945. James M. Andrews, sea walls, **72**, 945. Atlantic Dredging Co., dredging, 65 cents; rock, $35, **74**, ii, 317. Harbor Improvement Co., dredging, 85 cents, **74**, ii, 317. New England Dredging Co., dredging, 39 cents, **75**, ii, 406.

**1873.** James Andrews, sea walls, **73**, 1094; **74**, 313, 315. James M. Andrews, sea walls, **73**, 1086; **74**, 313, 315.

**1874.** W. H. Lloyd, rock removal, **74**, ii, 317. Boynton Bros., dredging, 38 cents, **75**, ii, 407.

**1875.** G. W. Townsend, Kelleys Rock, **75**, ii, 409. G. W. Townsend, rockwork, $39, **75**, ii, 410; **76**, 176. G. W. Townsend, rockwork, at $50–65, **77**, 180. Curtis, Fobes & Co., dredging, 75 cents, **75**, ii, 408. Curtis, Fobes & Co., Nash's Rock, **75**, ii, 409. Curtis, Fobes & Co., dredging, 18 cents, **75**, ii, 410; **76**, 176.

**1877.** New England Dredging Co., dredging, 24 cents, **77**, 177.

**1878.** Isaac A. Sylvester, granite and rock work, **78**, 209, 269. Cape Ann Granite Co., rubble stone, **78**, 269. Joseph E. Bartlett, dredging, 27 cents, **79**, 208.

**1879.** New England Dredging Co., dredging, 74 and 33 cents per c. y., **80**, 347.

**1880.** Moore & Wright, dredging, 39 cents per c. y., **81**, 515, 516. Eastern Dredging Co., dredging, 37 cents per c. y., **81**, 517.

**1881.** Eastern Dredging Co., dredging, 22 cents per c. y., **81**, 518. R. Hamilton, dredging, 19 cents per c. y., **81**, 518. Eastern Dredging Co., dredging, 37 cents per c. y., **82**, 513, 519.

**1882.** Eastern Dredging Co., dredging, 23 cents per c. y., **82**, 513, 519. H. W. Phillips, rock removal, $90 per c. y., **82**, 513. G. W. Townsend, rock removal, $35 per c. y., **83**, 454.

**1883.** J. McDermott, dredging, 39 cents per c. y., **83**, 454.

**1886.** Bay State Dredging Co., dredging in Fort Point Channel, 15 cents per c. y., **87**, 519.

**1887.** J. E. Chapman, dredging, 23 cents per c. y., **87**, 519.

**1888.** G. W. Townsend, rock removal, $22 per c. y., **88**, 455.

**1889.** Pigeon Hill Granite Co., granite ashlar, $4,747. New England Dredging Co., dredging, 35 cents per c. y.; removal of bowlders weighing over 6 t. each, $10. **89**, 579, 580.

**1890.** G. W. Townsend, rock removal, $29 per c. y. Bay State Dredging Co., dredging, 20 cents per c. y.; removal of bowlders, $8 per c. y. **90**, 505, 506. C. W. Lampee, dredging, in Nantasket Beach Channel, 25 cents per c. y., **91**, 653. New England Dredging Co., dredging in Nixs Mate Channel, 19½ cents per c. y., **91**, 653. A. R. Wright, dredging at Brewster Spit, 14 cents per c. y., **91**, 654. Rockport Granite Co., granite ashlar for Gallops Island, $3,917, **91**, 654.

**1891.** A. R. Wright, dredging in main ship channel, 17 cents per c. y., **91**, 654.

**1892.** A. B. Martin, dredging, Nastasket Beach channel, 24,324 c. y., 37 cents, **93**, 771. C. H. Souther, dredging Jeffries Point, 34½ cents per c. y. ($18,975). C. H. Souther and A. R. Wright, dredging 500,000 c. y. main ship channel, 49½ cents per c. y., **93**, 772.

**1894.** E. Townsend and C. W. Johnston, ledge removal, Nastasket Beach channel, $3,456.25; Boston Harbor, $144,562.56. C. H. Souther and A. R. Wright, dredging 155,555 c. y., Narrows, 29 cents per c. y. **95**, 628–629.

**1896.** A. B. Martin, dredging 24,137 c. y., Chelsea Creek, 29 cents per c. y., **97**, 846.

**1897.** Breymann Bros., dredging, Boston Harbor, 17½ cents per c. y. ($509,375.65), **97**, 847.

**1900.** Breymann Bros., dredging, Broad Sound, 35 cents per c. y. ($292,628.70), **1900**, 1202.

**Engineers.**

CHIEF OF ENGINEERS. Reports to Secretary of War on works necessary for preservation and improvement of Boston Harbor, Feb. 11, 1867, **67**, 476.

Reports, **66**, ii, 30–35; **67**, 17, 47; **68**, 68, 70; **69**, 59, 60; **70**, 76, 77; **71**, 87, 93; **72**, 86, 92; **73**, 102; **74**, 111; **75**, 117; **76**, 43; **77**, 37; **78**, 41; **79**, 49; **80**, 69; **81**, 73; **82**, 73; **83**, 68; **84**, 75; **85**, 63; **86**, 63; **87**, 26; **88**, 27; **89**, 38, 368; **90**, 33, 331; **91**, 40, 424; **92**, 46; **93**, 46; **94**, 44; **95**, 47; **96**, 48; **97**, 55; **98**, 61, 70; **99**, 71; **1900**, 81, 94.

BOARDS OF ENGINEERS.

Had extensive surveys made, 1860. Extract from report, **71**, 1885. (Gen. Totten, Prof. Bache, Commodore Davis.)

Convened at Boston July 20, 1889, by S. O. No. 38, to report upon the establishment of harbor lines in Boston Harbor. Reports, **89**, 601; **90**, 532. (Col. Abbot, Lt. Cols. Gillespie and Mansfield, and Maj. Livermore.)

Convened at Boston, Jan. 23, 1891,

by S. O. No. 38, to report upon the establishment of harbor lines in Boston Harbor. Report, **91**, 688. (Col. Abbot, Lt. Cols. Gillespie and Mansfield, and Maj. Livermore.)

ENGINEERS IN CHARGE.

Col. H. W. Benham, (Capt.) 1849, sea walls for protection of islands in Boston Harbor, **66**, ii, 33.

1866–1873. Reports, **66**, ii, 30; **67**, 467, 470; **68**, 833; **69**, 439; **70**, 460; **71**, 828; **72**, 923.

Lt. Col. S. Thayer, 1852, sea walls, **66**, ii, 34.

Maj. C. E. Blunt, **66**, ii, 32.

Col. J. D. Graham, 1864, sea walls, **66**, ii, 30, 34.

Lt. Col. J. G. Foster. Preservation and improvement of Boston Harbor, 1867 to 1871, **67**, 474.

Reports, **67**, 474; **68**, 806; **69**, 417; **70**, 464.

Removal of Tower and Corwin rocks, **68**, 811; **69**, 421.

History and scope of the works in Boston Harbor, **71**, 881.

Lt. Col. G. Thom, 1871–83. Reports, **71**, 878; **72**, 942; **73**, 1085; **74**, ii, 313; **75**, ii, 403; **76**, 167; **77**, 173; **78**, 207; **79**, 267; (Col.), **80**, 346; **81**, 515; **82**, 512; **84**, 588.

Maj. C. W. Raymond, 1883–86. Reports, **83**, 445; **84**, 503, 589; **85**, 502, 543, 545.

Maj. G. L. Gillespie, 1886–89. Reports, **86**, 564; **87**, 511; (Lt. Col.), **88**, 447.

Lt. Col. S. M. Mansfield, 1889–98. Reports, **89**, 572; **90**, 497; **91**, 645; **92**, 575, 584; **93**, 763; **94**, 549; **95**, 620; **96**, 603; **97**, 843; (Col.), **98**, 864, 886.

Col. C. R. Suter, 1899–. Reports, **99**, 1074; **1900**, 1194.

ASSISTANTS.

H. L. Whiting, U. S. C. S., surveys, **71**, 886.

Lt. M. B. Adams, **66**, ii, 34.

Capt. G. Burroughs, **67**, 46.

Capt. G. L. Gillespie, **69**, 59.

H. F. Bothfield, survey of "Narrows," **73**, 1089; **74**, ii, 316, 317. Report, **73**, 1094. Survey of Hingham Harbor, **75**, ii, 417. Reports, **75**, ii, 418; **85**, 546.

T. T. H. Harwood. Report, **98**, 890.

**Estimates.** (See *Plans* and *Projects.*)

**1852.** By Col. Benham, Great Brewster Island sea wall, $35,000, **66**, ii, 34.

**1866.** By Col. Benham, Great Brewster Island sea wall (repairs), $38,000, **66**, ii, 32. Lovells Island sea wall (repairs), $12,000, **66**, ii, 32. Lovells Island sea wall, southeast head (repairs), $25,000, **66**, ii, 33.

**1867.** By Col. Benham, Great Brewster Island connecting wall, $34,000, **67**, 469, 470. Lovells Island wall (additional), $12,500, **67**, 472. Deer Island wall (additional), $23,500, **67**, 473. By Lt. Col. Foster, Boston Harbor improvement,[a] $714,467, **67**, 475; **70**, 468.

**1869.** By Col. Benham, Deer Island wall (additional), $8,000, **69**, 441; **70**, 462.

**1870.** By Col. Benham, Lovells Island wall (additional), $15,000, **70**, 461; **71**, 829. Deer Island wall (additional), $18,000, **70**, 462; **71**, 829.

**1871.** By Lt. Col. Thom, Boston Harbor (additional), $231,000, **71**, 880.

**1873.** By Lt. Col. Thom, Boston Harbor (future work), **73**, 1092; **74**, ii, 321; **75**, ii, 410.

**1874.** By Lt. Col. Thom, Hingham Harbor, $11,000, **75**, ii, 418.

**1876.** By Lt. Col. Thom, completion of all work, $75,000, **76**, 177.

**1877.** By Lt. Col. Thom, completion of work, $55,000, **77**, 182. Man-of-war Shoal, $43,000, **77**, 183.

**1878.** By Lt. Col. Thom, Anchorage and Mystic River shoals, and Lower Middle Channel, $165,000, **78**, 218.

**1879.** By Lt. Col. Thom, final completion, $195,000, **79**, 270.

**Expenditures.** (See *Estimates*, *Financial statements*, *Operations*, *Plans*, and *Projects.*

1866–67, at Deer Island, $43.58 per l. f. of wall, **67**, 41; in 1867–68, $24 per l. f. of wall, **67**, 471.

At Rainsford Island sea wall to 1870, $22,353, **78**, 207.

At Great Brewster Island sea wall to 1870, $277,082.55, **76**, ii, 168; $269,000, **78**, 207.

At Deer and Lovell's islands, 1866–70, $133,420.24, **76**, ii, 168.

At Deer and Lovells islands, up to 1870, $322,000, **78**, 207.

Corwin and Tower Rocks, removal, cost, $31,228.61, **69**, 425.

Barrel Rock, removal, cost, $5,218, **70**, 465.

Hingham Harbor work, cost, $9,116.58, **76**, 45.

**Financial statements.** (See *Expenditures.*)

Deer Island, **66**, ii, 31. Deer and Lovell's islands, **67**, 47, 473; **69**, 61, 442; **70**, 76, 462; **71**, 829. Great Brewster Island, **66**, ii, 34; **67**, 470; **68**, 838; **69**, 60, 440; **70**, 464. Boston Harbor improvement, **68**, 820; **69**, 419; **70**, 77, 470; **71**, 94, 878; **72**, 93, 942; **73**, 104; **74**, ii, 321; **75**, ii, 411; **76**, 46, 177; **77**, 40, 182; **78**, 44, 218; **79**, 50, 267, 270.

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[a] By Chief of Engineers for same, **67**, 477; by harbor commissioners for same, $690,467.50, **76**, ii, 168; stated in detail as $725,467.50, **68**, 809. The estimated cost was exceeded 50 per cent, **76**, 177.

## BOSTON HARBOR, MASS.—Continued.

**Legislation.**

By Commonwealth of Massachusetts, appropriating $175 for purchase of land for Point Allerton sea wall, **68**, 808; providing for the sale of land on Long Island Head to the United States, **68**, 808; **69**, 418; asking appropriations from Congress (in 1843), **71**, 885; prohibiting the removal of stone, gravel, and sand from islands and headlands (1856), **71**, 885.

**Operations.**

**1825–32.** Sea wall built at Deer Island, **71**, 885.

**1836–38.** Sea wall built at Rainsford Island, **89**, 576.

**1843.** 750 l. f. sea wall built at Lovells Island, **66**, ii, 32; **71**, 885.

**1849–50.** 720 l. f. sea wall built at Great Brewster Island, **66**, ii, 31, 33, 34.

**1851.** Repairs to sea wall at Great Brewster Island, **66**, ii, 33.

**1853–54.** 640 l. f. sea wall built at Great Brewster Island, **66**, ii, 34.

**1864–65.** 150 l. f. sea wall built at Great Brewster Island and 300 l. f. at Deer Island, **66**, ii, 31, 35; **67**, 470.

**1866–67.** 490 l. f. sea wall built at Great Brewster Island and 340 l. f. at Deer Island, **67**, 467–469, 471. Rock work at Tower Rock, **68**, 68, 70; **69**, 421; **71**, 834.

**1867–68.** 550 l. f. sea wall built at Great Brewster Island and 826 l. f. at Deer Island. 92,899 c. y. dredged from Lovells Island, southwest point; rock work at Tower Rock (excavated to 23 f.), **68**, 68, 70; **69**, 421; **71**, 834.

**1868–69.** Paving sea wall at Great Brewster Island; 980 l. f. sea wall built at Deer Island, 800 l. f. at Lovells Island and 456 l. f. at Gallops Island. 66,909½ c. y. dredged from Lovells Island, southwest point, and 450 c. y. from Upper Middle Bar; rock work at Corwin Rock (excavated to 23 f.), **69**, 59, 417, 440, 441.

**1869–70.** 250 l. f. sea wall built at Great Brewster Island, filling sea wall at Deer Island, repairs to sea wall at Lovells Island, wharf at Point Allerton, 867 l. f. sea wall built at Gallops Island. 47,294¼ c. y. dredged from Lovells Island, southwest point; rock work at Barrel Rock (excavated to 23 f.), **70**, 460–470.

**1870–71.** 440 l. f. sea wall built at Point Allerton, 422 l. f. at Gallops Island and 670 l. f. at Long Island. 26,120 c. y. dredged from Upper Middle Bar; rock work at Kelleys Ledge (excavated to 23 f.), **71**, 87, 93, 828, 878.

**1871–72.** 219 l. f. sea wall built at Point Allerton; paving sea wall at Gallops Island and 540 l. f. sea wall built at Long Island. 20,305 c. y. dredged from Upper Middle Bar; rock work at Kelleys Ledge (excavated to 23 f.), **72**, 92.

**1872–73.** Jetty and apron at Lovells Island; 382.1 l. f. sea wall built at Point Allerton and 490 l. f. at Long Island. Rock work at Kelleys Ledge, wreck of *Delos*, **73**, 102, 1085–1093.

**1873–74.** Repairs to sea wall at Deer Island; 132.2 l. f. (1,005-f. apron, 8 jetties) sea wall built at Point Allerton; 1,655-f. apron and 9 jetties at Gallops Island, and 380⅓ l. f. sea wall at Long Island, 8,476 c. y. dredged from Upper Middle Bar; rock work at ledge in Narrows (excavated to 23 f.), **74**, 111, ii, 313.

**1874–75.** 975-f. apron and 10 jetties built at Long Island. 21,295 c. y. dredged from Lovells Island, southwest point; 52,755 c. y. from Upper Middle Bar, and 19,820 c. y. from Great Brewster Spit; survey at Hingham Harbor; rock work at Kelleys Ledge and State and Palmyra (excavated to 23 f.), **75**, 117, ii, 407, 408.

**1875–76.** 9,763 c. y. dredged from Lovells Island, southwest point; 95,002 c. y. from Upper Middle Bar, 9,406 c. y. from Great Brewster Spit, and 25,160 c. y. from Hingham Harbor; rock work at Kelleys Ledge, ledge in Narrows, and Hingham Harbor, **76**, 168 et seq.

**1876–77.** Repairs to sea wall at Deer Island. 64,136 c. y. dredged from Upper Middle Bar; rock work at Great Brewster Spit, Nashs Rock (excavated to 21 f.), and Kelleys Ledge, **77**, 173 et seq.

**1877–78.** Rebuilt sea wall at Lovells Island. 29,133½ c. y. dredged from Lovells Island, southwest point, and 1,484½ c. y. from Upper Middle Bar; rock work at ledge Middle Bar, Nashs Rock, and Kelleys Ledge, **78**, 207 et seq.

**1878–79.** Repairs to sea walls at Rainsford Island, Deer Island, Gallops Island, and Long Island, and rebuilt sea wall at Lovells Island. 46,000 c. y. dredged from Man-of-war Shoal; rock work at Upper Middle Bar, Nashs Rock (excavated to 20½ f.), and Kelleys Ledge, **78**, 268 et seq.

**1879–80.** 146 c. y. rock removed from Kellogs Ledge; 39,917 c. y. dredged from Man-of-war Shoals; 21,054 c. y. dredged from Anchorage; 47,953 c. y. dredged from Mystic River; sea wall repaired, **80**, 347.

**1880–81.** 30,409 c. y. dredged from Anchorage Shoals; 5,007 c. y. dredged from Low Middle Shoals; 33,114 c. y. dredged from Charles River; 48,343 c. y. dredged from Mystic River; 21,924 c. y. dredged from Nantasket Beach Channel; sea walls repaired, **81**, 516.

**1881–82.** 63,453 c. y. dredged from Anchorage Shoals; 48,530 c. y. dredged from Mystic River; 29,885 c. y. dredged

**BOSTON HARBOR, MASS.**—Continued.

from Charles River; 19,998 c. y. dredged from Nantasket Beach Channel; sea walls repaired, **82**, 513, 519.

**1882–83.** 40,327 c. y. dredged from Anchorage Shoals; 33,490 c. y. dredged from Mystic River; 12,500 c. y. dredged from Charles River; 50 c. y. rock removed from Nantasket Beach Channel; sea walls repaired, **83**, 447.

**1883–84.** 19,990 c. y. dredged from Nixs Mate Channel; 31,950 c. y. dredged from Castle Island Shoal; 57,631 c. y. dredged from Charles River; sea walls repaired, **84**, 504.

**1884–85.** Repairs to sea walls, **85**, 63.

**1885–86.** Repairs to sea walls, **86**, 63.

**1886–87.** 94,211 c. y. dredged from Fort Point Channel; repair to eastern sea wall at Lovels Island and south and middle walls at Deer Island, **87**, 512, 516.

**1887–88.** 69,000 c. y. dredged from main ship channel, **88**, 450.

**1888–89.** Repairs made to granite sea wall at Georges Island, by hired labor. 1,500 running f. of granite ashlar and 300 s. y. of shell-stone paving delivered on Gallops Island sea wall; work begun by hired labor on extension of sea wall; 146,556 c. y. dredged in "Upper and Lower Middles," **89**, 573, 574, 575.

**1889–90.** Extension of granite wall at Gallops Island completed by hired labor; repairs made to middle and north head walls at Deer Island by hired labor; 5,942 c. y. dredged and 111 c. y. ledge removed from "Upper and Lower Middles;" 9,025 c. y. dredged from Nantasket Beach Channel, **90**, 499, 500, 501.

**1890–91.** Construction of Gallops Island sea wall in progress; repairs to north and middle head walls at Deer Island, **91**, 647. 19,724 c. y. dredged from Nantasket Beach Channel, **91**, 651. 16,440 c. y. dredged from the west end of Brewster Spit, **91**, 652.

**1891–92.** Repairs to sea wall at Great Brewster Island; extension of sea wall at Gallops Island completed; 1,100 t. of rubble stone used as riprap protection for the beach west of sea wall at Long Island; 12,070 c. y. dredged from west end of Brewster Spit; 130,962 c. y. dredged in extension of main ship channel; 74,779 c. y. dredged from main ship channel at upper middle bar; 70,674 c. y. dredged from channel between Nixs Mate and Long Island, **92**, 576–581.

**1892–93.** Sea wall at Great Brewster Island repaired, and riprap at west end of the Long Island sea wall extended, **93**, 764. 137,213 c. y. dredged from Middle Shoal, **93**, 767. 21,594 c. y. dredged from Nantasket Beach Channel, **93**, 769. 20,697 c. y. dredged from Jeffries Point Channel, **93**, 770.

**1893–94.** Project for Jeffries Point and Nantasket Beach channels completed; 302,231 c. y. dredged from main ship channel (maps), **94**, 552–554.

**1894–95.** Ledge in Nantasket Beach Channel removed; dredging in main ship channel in progress; 80,048 c. y. dredged from the Narrows, **95**, 624–627.

**1895–96.** Ledge removal in progress; sea walls in course of repair, **96**, 604–605.

**1896–97.** Repairs made to about 150 feet of sea wall and about 400 feet of dike; in connection with preceding years, 6,421 c. y. ledge removed, **97**, 843–845. About 21,000 c. y. dredged from Chelsea Creek, **97**, 845.

**1897–98.** 228 l. f. sea wall repaired; 2,351 c. y. ledge removed from main ship channel; 479,308 c. y. dredged from Narrows, **98**, 865–867.

**1898–99.** Sea walls under repair; 671,394 c. y. dredged from main ship channel, **99**, 1075–1076.

**1899–1900.** Sea wall repairs in progress; 875,505 c. y. dredged, **1900**, 1195–1197.

**Physical characteristics.**

Of Deer Island, **66**, ii, 30; **67**, 472; of Lovell's Island, **66**, ii, 32; **67**, 472; of Great Brewster Island, **66**, ii, 33; of Tower Rock, **68**, 811; of Tower and Corwin Rocks, **69**, 422; of Barrel Rock, **70**, 465; of Point Allerton, **71**, 889; of Boston Harbor, **71**, 882; islands and anchorages, **71**, 882; destruction of islands, **71**, 884; extent of same, **71**, 886, 889; **74**, ii, 320; of Lovell's Island Shoals, **73**, 1089; of "Narrows," **73**, 1096; of Hingham Harbor, **75**, ii, 417, *et seq.;* of Man-of-war Shoal, **77**, 183.

Description of, **91**, 646.

Description of, survey of 1897, **98**, 887.

Storms damaging works, **1900**, 1195.

**Plans.** (See also *Projects.*)

For Hingham Harbor improvement, **75**, ii, 417, 419.

**Private (city) work.**

Surveys by city of Boston. (See *Surveys.*)

Estimates by harbor commissioners. (See *Estimates.*)

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Thayer, 1849, for Great Brewster Island sea wall, **66**, ii, 33.

By Col. Graham, 1865, for repairs of Deer Island sea walls, **66**, ii, 31.

By Lt. Col. Benham, 1866, for repairs, **66**, ii, 31.

By Lt. Col. Foster, for improvement of Boston Harbor by dredging, sea walls,

## BOSTON HARBOR, MASS.—Continued.

and removal of rocks, **67**, 474; **70**, 468.

By Lt. Col. Thom, 1873, for new work, removing Nashs Rock, Narrows Rock, State Rock, and wreck of Delos, **73**, 1091.

By Lt. Col. Thom, 1874, for sundry rock work, **74**, ii, 318.

By Lt. Col. Thom, 1875, for improving Hingham Harbor, **75**, ii, 410, 418.

By Lt. Col. Thom, 1878, for Anchorage Shoal, Lower Middle Bar, and Mystic River, **78**, 217.

The projects for the improvement of Boston Harbor have had for their object, first, its preservation by protecting the shores of the islands and headlands by sea walls, aprons, and jetties, thus preventing additional wash into the channels, controlling the tidal scour, and preserving the full height of anchorage shelter for vessels in the roadsteads; secondly, the improvement of the harbor by widening, deepening, and straightening the channels through dredging and rock removal, **90**, 498.

The improvements undertaken since 1866 have been projected as the necessities of the harbor required, being in general conformity with the recommendations of the U. S. commissioners, whose labors terminated in 1866.

The projects in detail have been as follows: Protection of western shore line of Georges Island by stone apron, to cost $10,000, **88**, 449. Increased in 1889 to $35,000, **89**, 579. Extension of sea wall at Gallops Island, to cost $15,000, **88**, 449. Repair and extension of rubblestone apron protection to Long Island, to cost $3,000, **88**, 449. Construction of sea walls at south and east bluffs of Governors Island, to cost $80,000, **88**, 450.

In 1867 it was proposed to dredge the main ship channel to a depth of 23 f. at m. l. w., 1,000 f. wide at the "Upper" and "Lower Middles," and 685 f. wide at the "Narrows." In 1870 the proposed width at the Narrows was reduced to 625 f., and increased to 1,100 at Anchorage Shoal in the inner harbor. In 1887 it was proposed to straighten the passage through the "Narrows" by cutting off a spur projecting from Lovells Island. In 1888 it was estimated that to complete the improvement of the main ship channel would require 687,000 c. y. to be dredged from the "Upper Middle" in the inner harbor, estimated cost, $250,000, **88**, 450, 451.

The project proposed by Maj. Raymond in 1885 for the improvement of the Fort Point Channel was for the excavation of a channel 175 f. wide and 23 f. deep at m. l. w., from the entrance to near Federal Street Bridge, 4,100 f.; estimated cost, $100,000. $60,000 still required for completion in 1888. **88**, 452, 453.

The project for improvement of the channel between Nixs Mate and Long Island, adopted in 1883, was to dredge a channel 200 f. wide, 12 f. deep at m. l. w., and about 550 f. long. In 1887 it was recommended that the axis of the cut be shifted 30° to the westward, and that it be widened to 300 f., 15 f. deep at m. l. w. The original project was estimated to cost $9,000. The project as revised in 1887 was estimated at $25,000. **88**, 453, 454. A survey of the main ship channel east of Long Island Head was provided for in 1888, at a cost of $6,000, **88**, 454.

The general project in 1889 included, in addition to the above, a project for the extension of Point Allerton sea wall, to cost $15,000, and for the repair of Great Brewster Island sea wall, to cost $10,000, **89**, 579. Also, in 1890, a project for dredging at the west end of Brewster Spit, to cost $15,000, **90**, 505.

The aggregate cost of the foregoing projects is $455,000, and the aggregate estimate for completion in 1890 was $395,000, **90**, 505.

The project for improving Boston Harbor by the excavation of a channel of 23 f. depth at m. l. w. having been essentially completed in 1891, Lt. Col. Mansfield proposed deepening the main ship channel in Boston Harbor to 30 f. m. l. w.; estimated cost, $1,500,000, **92**, 584.

By Lt. Col. Mansfield, 1892, for revising project to provide for a 27-f. channel 1,000 f. wide in main ship channel, m. l. w.; estimated cost, $1,250,000, **93**, 766.

By Lt. Col. Mansfield, 1893, for expenditure of available funds in improvement of main ship channel, **93**, 767; for use of available funds for Nantasket Beach channel in obtaining a depth of 12 f., m. l. w., **93**, 769; and for completion of project for Jeffries Point channel with available funds, **93**, 770.

By Lt. Col. Mansfield, 1894, for an 18-f. channel, 150 f. wide in Chelsea Creek, m. h. w., to head of navigation; estimated cost, $65,000, **95**, 649.

In 1898 Col. Mansfield estimated it would cost $858,750.78 to complete the project of 1892, **98**, 867.

By Col. Mansfield, 1898, for dredging a 30-f. channel in main ship channel, m. l. w., from President Roads through Broad Sound channel; estimated cost, $481,941.57, **98**, 867, 889.

By Col. Suter, 1900, for removal of some ledges uncovered in main ship channel; estimated cost, $75,900, **1900**, 1197.

## BOSTON HARBOR, MASS.—Continued.

**Surveys.**

Made by the harbor commissioners of Boston during several years, **67**, 477.

Extensive surveys made, 1856, by U. S. Coast Survey at cost of city of Boston for the U. S. commission, **71**, 885.

Of Narrows, by H. F. Bothfield, C. E., 1872, **73**, 1089. Report, **73**, 1095.

For sunken rocks, 1873, **74**, 114, ii, 316, 317, 319.

Of Hingham Harbor, 1874, **75**, ii, 410. Report, **75**, ii, 417.

Of Man-of-war Shoal, 1877. Report, **77**, 183.

Of Anchorage Shoal and mouth of Mystic River, 1878, **78**, 216.

Of lower part of harbor, 1884, **85**, 504.

Survey of Fort Point Channel ordered by act of Aug. 2, 1882, made under direction of Maj. Raymond, who reported that a survey had just been made by the State of Massachusetts, **84**, 588.

Examination of Fort Point Channel ordered by act of July 5, 1884, made under the directions of Maj. Raymond, **85**, 545.

Detailed survey of lower harbor from Long Island to the sea, with bottom examinations and current observations, made, 1888, under direction of Lt. Col. Gillespie, **88**, 451.

Detailed survey of channel between Brewsters Spit and Georges Island Shoal, made, 1890, under direction of Lt. Col. Mansfield, **90**, 501.

Survey with a view to securing a 30-f. channel, 1,200 f. wide, from the navy-yard to the entrance to the existing ship channel, and from the main ship channel in President Roads through Broad Sound channel, ordered by act of June 3, 1896, made, 1897, under direction of Col. Mansfield (report partly favorable) (see *Projects*), **98**, 886.

Survey for 35-f. channel in progress, 1900, **1900**, 1199.

MAPS:

Of Boston Harbor, **80**, 348; **83**, 454; **87**, 517.

Of Charles River Harbor, **84**, 512.

Of channel between Nix's Mate and Long Island, **87**, 517; **88**, 454.

SKETCHES. Location of works, **75**, ii, 404; sea walls at Point Allerton, Gallops Island, and Long Island, **75**, ii, 406.

## BOUQUET RIVER, N. Y.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 330; **91**, 388.

ENGINEERS IN CHARGE:

Maj. W. McFarland, 1884. Report, **84**, 2162.

Maj. M. B. Adams, 1891. Report, **91**, 2940.

ASSISTANT. J. A. Gillespie. Report, **84**, 2163.

**Physical characteristics.**

Description, **91**, 2940.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Maj. McFarland (report unfavorable), **84**, 2162.

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Adams (report unfavorable), **91**, 2940.

## BOWMANS RIVER TO CUMBERLAND, MD., Canal.[a]

## BRANDYWINE RIVER, DEL. (See *Christiana River; Wilmington Harbor, Del.*)

**Commerce.**

Important, **84**, 881, 885.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 139.

ENGINEER IN CHARGE. Lt. Col. G. Weitzel, 1884. Reports, **84**, 879, 882.

ASSISTANTS:

E. A. Giesler. Report, **84**, 880.

J. H. Dager. Report, **84**, 833.

**Physical characteristics.**

**84**, 883.

**Plans.**

By Lt. Col. Weitzel, 1883, for dredged channel, mouth to Market Street Bridge, Wilmington, from 50 to 100 f. wide and from 6 to 9 f. deep; estimated cost, $96,525, **84**, 883, 884.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under the direction of Lt. Col. Weitzel, 1882, **84**, 879.

Survey made in 1883, **84**, 882.

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[a] Survey.—Report, Apr. 19, 1826. (H. Doc. No. 482, 55th Cong., 2d sess.)

## BRANFORD HARBOR, CONN.

**Commerce.** (See *Plans.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 99.

ENGINEERS IN CHARGE:

Maj. J. W. Barlow. Report, **84**, 678.
Maj. W. McFarland. Report, **84**, 679.

ASSISTANT. H. N. Babcock. Report, **84**, 680.

**Plans.**

The commerce of the port, 1883, would not justify expending $78,000 required to form a channel 100 f. wide and 9 f. deep through the shoal areas in the harbor, **84**, 679, 680.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under the direction of Maj. Barlow, **84**, 678.

Survey made under direction of Maj. McFarland (see *Plans*), **84**, 679.

## BRAZOS RIVER AND GALVESTON BAY, TEX., channel between.[a]

**Commerce.**

Description of, **97**, 1812, 1813.

The route examined, 1896, a regulator of freight rates between certain Brazos River points and Galveston, **97**, 1810.

Part of the route examined, 1896, runs through a canal of the Galveston and Brazos Navigation Co., which company, under its charter from the State of Texas, collects toll from passing craft, **97**, 1810.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 204; **97**, 298.

ENGINEERS IN CHARGE:

Maj. S. M. Mansfield, 1881. Report, **81**, 1376.

Maj. A. M. Miller, 1897. Report, **97**, 1809.

ASSISTANTS:

W. L. Webb. Report, **81**, 1376.
Lt. W. V. Judson. Report, **97**, 1811.

**Physical characteristics.**

Description of, **81**, 1377; **97**, 1810.

**Plans.**

By Maj. Mansfield, 1880, for constructing a canal about 38 miles long, 80 f. wide, and 4 f. deep. Estimated cost, $70,353. **81**, 1376, 1379.

**Surveys.**

Ordered by act of Mar. 3, 1879, **81**, 204.

Examination ordered by act of June 3, 1896; made in that year under the direction of Maj. Miller (report unfavorable), **97**, 1809.

**BRAZOS RIVER, TEX.** (See *Brazos River, between Velasco and Richmond; Mouth of Brazos River; Double Bayou, and the mouths of adjacent streams, Tex.; Sabine River, etc., Trinity River; West Galveston Bay Channel.*)

**Appropriations.**

1880, $40,000, **80**, 1244.
1881, 40,000, **81**, 1350.
1882, 50,000, **82**, 1462.
1884, 10,000, **84**, 1310.
1886, 18,750, **86**, 1328.
1896, 5,000, **97**, 1808.
1896, 5,000, **97**, 1816 (survey).

Total, 168,750

**Commerce.**

Description of, **75**, 936; **81**, 1350; **93**, 1895; **95**, 1838, 1839.

Large and important, Velasco to Richmond, **95**, 1838.

Relating to works of Brazos River Channel and Dock Co., **97**, 1831.

The Board, 1896, was of opinion that the maintenance of the river mouth harbor was of sufficient public interest to justify the United States in completing the works of the Brazos River Channel and Dock Co., provided that the company would dedicate to the public one mile of the river front lands at the mouth, and was also of the opinion that the enhanced value of the property of the company, which would arise from the Government taking charge of the harbor works, would be sufficient compensation for their transfer to the Government, **97**, 1826.

The freight carried between Velasco and Richmond about 15,435 tons annually, **99**, 344.

**Contracts.**[b]

**1881.** Kanters & Son, jetty construction, **81**, 1347. G. L. Long, jetty construction, **82**, 1461.

**1882.** R. Moore, jetty construction, **83**, 1087.

**1884.** F. A. Brock, **85**, 1461.

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[a] Survey.—Report, Apr. 1, 1854, estimate, $44,000. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] Cost of works of the Brazos River Channel and Dock Co., 97, 1822.

## BRAZOS RIVER, TEX.—Continued.

**Defense.**

Adaptability as a naval station, **79**, 938.

Recommendations concerning, by Maj. Howell, **79**, 944, 945.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 89; **78**, 85; **79**, 111, 112; **80**, 148; **81**, 201, 1351; **82**, 198; **83**, 203; **84**, 218; **85**, 228; **86**, 225; **87**, 191; **88**, 175, 1293; **89**, 205; **91**, 235; **93**, 257; **95**, 266; **96**, 230; **97**, 297, 298; **98**, 287; **99**, 344; **1900**, 392.

BOARDS OF ENGINEERS.

Permanent Board on river and harbor improvement. Report of, **81**, 1352. (See *Projects*.)

Convened at New York, Nov. 11, 1887, to report upon improvement of mouth of the Brazos River. Reports, **88**, 1299. (Cols. Casey and Abbot, Lt. Col. McFarland, and Maj. King.)

A Board of Engineers, under instructions from the Secretary of War dated Dec. 2, 1896, convened at Velasco, Tex., and in Washington, D. C., to ascertain the character and value of improvements made at the river mouth by the Brazos River Channel and Dock Co. Report (see *Commerce*), **97**, 1815. (Col. H. M. Robert; Civil Engineer R. Moore, St. Louis, Mo., and Stehman Forney, U. S. Coast and Geodetic Survey.)

ENGINEERS IN CHARGE:

Maj. C. W. Howell, 1874–80, **75**, 79; **78**, 82; **79**, 111. Reports, **75**, 929, 937; **79**, 938; **80**, 146.

Maj. S. M. Mansfield, 1880–86. Reports, **80**, 1242; **81**, 1347; **82**, 1460; **83**, 1087; **84**, 1309; **85**, 1460; **86**, 1327.

Maj. O. H. Ernst, 1886–89. Reports, **87**, 1427; **88**, 1291, 1294; **89**, 1563.

Maj. A. M. Miller, 1893–97. Reports, **93**, 1893; **95**, 1833, 1838; **97**, 1808, 1815.

Maj. J. B. Quinn, 1898. Report, **98**, 1511.

Capt. C. S. Riché, 1899–. Reports, **99**, 1970; **1900**, 2335.

ASSISTANTS:

R. B. Talfor, **75**, 929; **79**, 938. Report, **75**, 929.

H. C. Ripley, **79**, 938. Report, **79**, 939.

J. M. Picton, **82**, 1462.

H. C. Ripley. Report, **87**, 1428.

Lt. W. C. Langfitt. Report, **93**, 1896.

S. W. Campbell. Report, **95**, 1835.

S. M. Wilcox. Report, **95**, 1840.

**Legislation.**

Texas, under a general law, sanctioned the organization of the Brazos River Channel and Dock Co., with authority to extend its works for the improvement of the river mouth as far inland as might be necessary to obtain security from storms, etc., **93**, 1893; **97**, 1818.

Congress, 1888, authorized the company to construct, own, and operate jetties and other similar works at the river mouth, and to charge and collect tolls therefor, subject to regulation, provided that the work should be satisfactorily done in a defined period, and the right was reserved to purchase the works, **97**, 1819.

**Obstructions.**

Bridges obstructing navigation, **75**, 936.

List of railroad and other bridges without draws between Waco and Richmond, **95**, 1833.

**Operations.**

**1880–81.** Partial construction of 742½ l. f. of north channel jetty, **81**, 1348.

**1881–82.** Work on north jetty in progress, **82**, 1461.

**1882–83.** Work in progress on north and south jetties, **83**, 1088.

**1884–85.** Work in progress on north jetty, **85**, 1461. The north jetty has been partly completed throughout a length of 2,433 l. f. The south jetty foundation course laid for 700 f., **86**, 1327.

**Physical characteristics.**

Description of, **75**, 930, 931, 932, 933, 937, 940, 941, 943, 944; **88**, 1294; **93**, 1894; **95**, 1833; **97**, 1817.

List of obstructions, **75**, 930, 931, 934.

Current observations, **75**, 932, 937; **79**, 942; **97**, 1837.

Table of distances, **75**, 933.

"Littoral currents," **75**, 937, 940; **97**, 1839.

Table of gauge readings, **79**, 941.

Slight tides in river, **81**, 1349, 1353.

One of the principal rivers of Texas, about 800 miles long, flowing through its central and agricultural portion into Gulf of Mexico without intervention of a bay, having a bar at the mouth, the position of which was considered in 1897 to be as variable as the depth of the channel through it, **97**, 1817. Richmond distant about 102 miles from the mouth, up to which place in 1892 navigation was obstructed by snags, etc., **93**, 1896. Between Waco and Richmond, 328 miles, navigation was obstructed in 1895 by ledges, shoals, and railroad and other bridges without draws, **95**, 1833. From Velasco to Richmond, 89 miles, the river tortuous, banks varying in height from 9 to 47 f., and obstructed by shoals, snags, and a fall of 1½ f. at Bolivar Landing, **95**, 1838.

Effect of works of improvement, **97**, 1821.

## BRAZOS RIVER, TEX.—Continued.

Tidal observations at mouth, **97,** 1836, 1839.

Surface slope observations, **97,** 1837.

Changes in the river banks and in the Gulf shore line, **97,** 1838.

**Plans.**

By Maj. Howell, 1879, for a harbor of refuge and naval station; for widening and deepening of channel; estimated cost, $12,052 to $1,762,575, **79,** 944, 945. For a basin 1,000 f. by 500 by 30 f.; estimated cost, $157,407, **79,** 944 945.

**Private (State and corporate) work.**

The State of Texas expended, 1857–58, $60,000 in an improvement of the river from mouth to Washington, 255 miles, **75,** 934. Improvement insufficient, **75,** 935.

The improvement of the river mouth was carried on from 1888–96 by the Brazos River Channel and Dock Co., during which time 2 straight and parallel jetties were built, placed 560 f. apart, center to center, the east one being 4,708 and the west 5,018 f. long; wing dams were built from these at intervals, and out from the banks for about 5 miles upstream to Velasco, **93,** 1893; **97,** 1820, 1821. History of the company, **97,** 1818.

**Projects.**

By Maj. Howell, 1872, for the improvement of channel over the bar at mouth of river by means of two converging pile jetties, each five-eighths of a mile long and 400 f. apart at their outer ends; estimated cost, $286,484, **75,** 938,941; **80,** 1243. The work not considered susceptible of permanent completion, **80,** 1244.

By Maj. Mansfield, 1880, for parallel jetties of brush, stone, and concrete; their direction to be chosen so as to fix the channel in its natural position. Approximate length of north jetty, 3,600 f.; of south jetty, 4,350 f.; estimated cost, $522,890.44, **81,** 1349. Recommended by the Board of Engineers, **81,** 1355. Concurred in by Chief of Engineers, and approved by Secretary of War, **81,** 1352.

In 1887 the $140,833 expended had not resulted in any useful effect upon the bar; the plan for improvement to receive further consideration, **87,** 191.

In 1887, upon consideration of Maj. Ernst's report on the results of the survey of that year, the Board of Engineers recommended that no further works of improvement be at present attempted, **88,** 1300.

By Maj. Miller, 1895, for removing obstructions from the river between Velasco and Richmond; estimated cost, $10,000, and an annual expenditure of $2,500 for maintenance, **95,** 1839.

History of projects for deepening entrance to river, **97,** 1818.

See *Commerce.*

**Surveys.**

Of Brazos River below Waco, including bar at its mouth, by R. B. Talfor, 1874, **75,** 80, 929.

Of river from a point 8 miles above its mouth to outer bar, by H. C. Ripley, 1878, **78,** 85; **79,** 111, 112. Report, **79,** 939.

Of mouth of Brazos River, made, 1887, under direction of Maj. Ernst, **88,** 1294.

Examination from its mouth to Richmond, ordered by act of July 13, 1892, made in that year under direction of Maj. Miller (report favorable to limited improvement), **93,** 1893.

Examination from Waco down to Richmond, ordered by act of Aug. 20, 1894 (report unfavorable); the same act also ordered a survey from Velasco up to Richmond. Both were made, 1895, under direction of Maj. Miller (see *Projects*), **95,** 1833, 1838.

Investigation of the character, value, etc., of the improvements made at the mouth by the Brazos River Channel and Dock Co., ordered by act of June 3, 1896, made, 1896–97, by a Board of Engineers, **97,** 1815. Surveys were made under direction of this board by the Coast and Geodetic Survey, which detailed to that work, H. L. Marindin. Report, **97,** 1836. Report of Civil Engineer Corthell, representing the company, **97,** 1840.

MAPS:

**95,** 1844.

Sketch of mouth, **75,** 936.

List of maps relating to improvement of river mouth (not printed), **97,** 1834.

## BRAZOS RIVER, TEXAS, Mouth of. (See *Brazos River.*)

**Appropriations.**[a]

1899, $85,000, **99,** 1969.

**Contract.**

**1899.** C. Clarke & Co., stone, $2.69 and $3.59 per t.; logs in place, 20 cents per l. f. ($68,105), **1900,** 2333.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99,** 343, 346; **1900,** 390, 396.

ENGINEERS IN CHARGE:

Capt. C. S. Riché, 1899–. Reports, **99,** 1969, **1900,** 2332, 2426.

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[a] The unexpended balance of appropriation, act of Aug. 5, 1886, amounting to $16,651.57 (See *Brazos River*), was realloted Mar. 3, 1899, **1900,** 2332.

## BRAZOS RIVER, TEXAS, Mouth of—Continued.

Col. H. M. Robert. Report, **99**, 1977.

ASSISTANTS:

S. W. Campbell. Report, **1900**, 2334.
E. M. Hartrick. Report, **1900**, 2433.
R. B. Talfor. Report, **1900**, 2435.

**Legal proceedings.**

The Brazos River Channel and Dock Co., Apr. 25, 1899, transferred to the United States jetties and auxiliary works, also a release of rights and privileges conferred upon it by its charter or by act of Aug. 9, 1898, **99**, 1969.

By act of June 3, 1896, it would seem that it was unlawful for the Senate to require the examination called for Jan. 28, 1899, **99**, 1977.

**Operations.**

**1899–1900.** Construction of northeast and southwest jetties in progress, **1900**, 2332.

**Physical characteristics.** See *Surveys.*

**Projects.**

By Col. Robert, 1899, for putting the existing jetties in the mouth of the creek in a fair condition to protect a dredge while working in the channel; also for beginning to construct spur dikes to narrow the channel between the jetties, and for dredging a channel to a depth of 18 f. m. l. t., and 150 f. wide, estimated cost, $250,000, **99**, 1978; **1900**, 2332.

Capt. Riché estimated, 1900, it would cost (1) $1,265,000 to extend the jetties one-half mile; (2) $200,000 to dredge and to build a system of spur dikes to contract the channel to 440 f. between jetties, with $30,000 annually for maintenance; (3) $1,300,000 for a 20-f. channel, 150 f. wide, by jetty extension, spur dikes, and dredging, with $30,000 annually for maintenance, or $375,000 for dredging alone, with $40,000 annually for maintenance, **1900**, 2428.

**Surveys.**

Survey and estimates for improving the mouth of Brazos River near Velasco, Tex., with all information for continuing the work done by the Brazos River Channel and Dock Co., or otherwise, with probable cost, ordered, Jan. 28, 1899, by a resolution of the Senate of the United States; data from the report of the Board of Engineers, 1896, submitted, 1899, by Col. Robert (see *Legal proceedings; Projects*), **99**, 1977.

Examination and survey of mouth of Brazos River, Tex., with estimates of cost of (1) extending the jetties one-half mile; (2) of the depth and width of channel to be obtained by such extension; (3) and cost of obtaining a 20-f. channel, 150 f. wide, ordered by act of Mar. 3, 1899, made, 1900, under direction of Capt. Riché (see *Projects*), **1900**, 2426.

Description of soundings, triangulations, levels, and cross sections, **1900**, 2436.

## BRAZOS RIVER (between Velasco and Richmond), WEST GALVESTON BAY CHANNEL, DOUBLE BAYOU, AND MOUTHS OF ADJACENT STREAMS, TEX. (See *Brazos River, Tex.; West Galveston Bay*, channel in; *Trinity River, Velasco Harbor*, and *Surveys, Tex.*)

**Appropriation.**[a]

1899, $65,000, **99**, 1970.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99**, 343; **1900**, 391.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–. Reports, **99**, 1970; **1900**, 2334.

**Projects.** (See *Appropriations.*)

The project, 1899, to obtain and maintain a navigable channel 4 to 6 feet deep across the bars at the mouths of most of the streams and bayous along the Texas coast, with a dredging and snagging plant owned and operated by the United States, **99**, 344.

## BRAZOS SANTIAGO HARBOR, TEX.[b]

**Appropriations.**

| | | |
|---|---|---|
| 1878, | $6,000, | **78**, 111. |
| 1880, | 25,000, | **80**, 1273. |
| 1881, | 75,000, | **81**, 1367. |
| 1882, | 60,000, | **82**, 1477. |
| 1884, | 25,000, | **84**, 1318. |
| 1886, | $37,500, | **86**, 1335. |
| 1888, | 25,000, | **88**, 1320. |
| Total, | [c]253,500 | |

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[a] The funds available at the end of the fiscal year 1899 for improving Brazos River, Tex., channel in West Galveston Bay, and Trinity River, Tex., to be used in dredging and snagging at those points in connection with the appropriation of 1899, **99**, 1970.

[b] Survey. Report Apr. 18, 1853. (H. Doc. No. 482, 55th Cong., 2d sess.)

[c] The balance of $57,476 returned to the Treasury, 1895, was reallotted, 1900; **1900**, 2340.

## BRAZOS SANTIAGO HARBOR, TEX.—Continued.

**Commerce.**

Important, **71,** 544. Obstructions to commerce, **79,** 111.

Light and decreasing, **93,** 1891; **95,** 1831.

Without water communication the locality at Brazos Santiago, off Point Isabel, never to prosper; business is falling off, 1900, and the country gradually being deserted; **1900,** 2470.

**Contracts.**

**1878.** New Orleans Wrecking Co., removal of wreck, **79,** 920.

**1881.** G. L. Long, jetty construction, **82,** 1476.

**1883.** R. Moore, jetty construction, **84,** 1317.

**1884.** R. Moore, jetty construction, **85,** 1469.

**Engineers.**

Chief of Engineers. Reports, **70,** 32, 62; **71,** 67; **79,** 111; **80,** 149; **81,** 203, 204; **82,** 200; **83,** 205; **84,** 220; **85,** 229; **86,** 226; **87,** 192; **88,** 176; **89,** 206; **90,** 185; **91,** 234; **92,** 227; **93,** 257; **94,** 239; **95,** 265, 266; **99,** 346; **1900,** 393, 397.

Board of Engineers. River and harbor improvements. Report, **82,** 1489. (See *Projects.*)

Engineers in Charge:

Capt. McClellan, 1853. Report (extract), **71,** 545.

Maj. C. W. Howell, 1870–80. Reports, **71,** 544; **79,** 919; **80,** 146.

Maj. S. M. Mansfield, 1880–86. Reports, **80,** 1272; **81,** 1365; **82,** 1475, 1480; **83,** 1094; **84,** 1316; **85,** 1468; **86,** 1334.

Maj. O. H. Ernst, 1886–91. Reports, **87,** 1433; **88,** 1320; **89,** 1568; **90,** 1813.

Maj. C. J. Allen, 1891–92. Reports, **91,** 1930; **92,** 1553.

Maj. A. M. Miller, 1893–95. Reports, **93,** 1890; **94,** 1413; **95,** 1819, 1830.

Capt. C. S. Riché, 1900–. Reports, **1900,** 2340, 2469.

Assistants:

Lt. H. M. Adams, **71,** 67. Report, **71,** 544.

H. S. Douglass. Report, **79,** 920.

H. C. Ripley. Reports, **81,** 1367; **82,** 1477, 1482.

J. G. Wright. Report, **83,** 1095.

Lt. W. L. Fisk. Report, **84,** 1318.

Lt. G. A. Zinn. Report, **88,** 1327.

E. M. Hartrick. Report, **1900,** 2471.

**Operations.**

**1868.** Closing of Pass of Boca Chica in order to increase amount of water flowing through Brazos Pass, **71,** 545.

**1878–79.** Wreck of bark *Réne des Mers* removed from harbor, **79,** 920.

**1881–82.** Construction of south jetty commenced and 495 l. f. partly completed, **82,** 1476.

**1882–83.** Work in progress over 2,300 l. f. of south jetty. Delay from yellow fever. **83,** 1095.

**1883–84.** Work in progress on south jetty, **84,** 1317.

**1884–85.** Work in progress on south jetty; total length of 3,500 f., **85,** 1468; **86,** 1334.

**1886–87.** Survey of harbor in progress, **87,** 1433.

**Physical characteristics.**

General, **71,** 544, 545.

Description of pass, **81,** 1368; **82,** 1489.

Gradual filling of harbor, **81,** 1369.

Small rise of tides, **82,** 1490.

Dimensions of harbor as shown by surveys from 1867 to 1887; stability of sand bottom, **88,** 1326.

Brazos Santiago, the pass or channel of communication between the Gulf of Mexico and Laguna Madre; it affords the only navigable approach to Point Isabel, the port of the frontier town of Brownsville, on the Rio Grande, **1900,** 2469.

**Plans.** (See *Projects.*)

By Lt. Adams, a jetty, foundation to be constructed by covering bottom with a layer of gunny sacks filled with hydraulic concrete, above the foundation the jetty to be built of blocks of hydraulic concrete, the jetty to concentrate the whole action of outward current upon one part of the bar. Estimate, $775,000. **71,** 67, 545, 546.

**Project.** (See *Plan.*)

By Maj. Howell, removal of wreck, **79,** 919.

By Maj. Mansfield, 1881, deepening the channel across the bar and the maintenance of a suitable harbor inside the pass, with two parallel jetties at the mouth of the river extended to the 12-f. curve, and a dam from Point Isabel to Brazos Santiago closing the lagoon, the south jetty to be 3,630 f. and the north jetty 2,940 f. long. Estimate, $678,084.50. **81,** 1367, 1372; **82,** 1478, 1481, 1489, 1490; **86,** 1334.

Approved by Board of Engineers, 1881, so far as the application of available funds to construction of south jetty would permit, **82,** 1490; **86,** 1335; **87,** 1433.

In 1888, the works theretofore constructed having practically disappeared, Maj. Ernst estimated the cost of reconstruction of both jetties at $1,130,000, **88,** 1321.

The total of expenditures under appropriations at the date of rendering the above estimate was $188,590, making the revised estimate from the annulment of the work $1,318,590, **91,** 1931; **92,** 1554.

Project, 1900, to hire a dredging plant to dredge channel over the bar to give temporary relief to the locality, **99,** 2340.

## BRAZOS SANTIAGO HARBOR, TEX.—Continued.

**Surveys.**

By Lt. Adams. Report, **71**, 544.

From Brazos Santiago to Point Isabel, ordered by act of Mar. 3, 1881, made under direction of Maj. Mansfield, 1882, **82**, 1477.

Of harbor and bar, made 1887, under direction of Maj. Ernst, **88**, 1322.

Examination of the bar and harbor ordered by act of Aug. 17, 1894, report submitted by Maj. Miller, 1894 (report unfavorable), **95**, 1830.

Examination of harbor at Brazos Santiago, off Point Isabel, Tex., with a view to removing bars and to furnishing an inlet to permit ocean-going vessels to enter the harbor, ordered by act of Mar. 3, 1899, made, 1899, under direction of Capt. Riché (report unfavorable), **1900**, 2469.

MAPS. **82**, 1478; **84**, 1318.

## BRAZOS SANTIAGO RIVER. (See *Sabine River, etc.*)

## BRETON BAY, MD. (Leonardtown Harbor).

**Appropriations.**

| | | | |
|---|---|---|---|
| 1878, | $5,000, | **78**, | 72, 573. |
| 1879, | 4,000, | **79**, | 83, 601. |
| 1880, | 3,000, | **80**, | 756. |
| 1881, | 3,000, | **81**, | 951. |
| 1882, | 5,000, | **82**, | 1012. |
| 1884, | 3,000, | **84**, | 981. |
| 1886, | 6,500, | **86**, | 902. |
| 1888, | 3,000, | **88**, | 816. |
| 1890, | 5,000, | **90**, | 1062. |
| Total, | 37,500 | | |

**Commerce.**

Important, **75**, ii, 109; **78**, 513.

Description of, **1900**, 1744.

**Contracts.**

**1878.** G. H. Ferris, dredging, 12½ cents per c. y., **79**, 600.

**1879.** G. C. Fobes & Co., dredging, 16 cents per c. y., **80**, 756.

**1880.** National Dredging Co., dredging, 15 cents per c. y., **81**, 950.

**1881.** National Dredging Co., dredging, 15¾ cents per c. y., **82**, 1011.

**1882.** Potomac Dredging Co., dredging, 18 cents per c. y., **83**, 797.

**1884.** T. P. Morgan, dredging, 12 cents per c. y., **85**, 964.

**1886.** National Dredging Co., dredging, 11 cents per c. y., **87**, 930.

**1888.** Atlas Dredging Co., dredging, 13½ cents per c. y., **89**, 1001.

**1891.** Baltimore Dredging Co., dredging, 12½ cents per c. y., **91**, 1258.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 90; **78**, 72; **79**, 83; **80**, 112; **81**, 152; **82**, 147; **83**, 152; **84**, 155; **85**, 145; **86**, 140; **87**, 107; **88**, 109; **89**, 126; **90**, 112; **91**, 140; **92**, 141; **99**, 223; **1900**, 254.

ENGINEERS IN CHARGE.

Maj. Wm. P. Craighill, 1874. Report, **75**, ii, 108.

S. T. Abert, U. S. Agent, 1878–91. Reports, **78**, 512; **79**, 600; **80**, 756; **81**, 949; **82**, 1009; **83**, 797; **84**, 981; **85**, 964; **86**, 901; **87**, 928; **88**, 815; **89**, 1001; **90**, 1062.

Lt. Col. P. C. Hains, 1891–92. Report, **91**, 1258.

Maj. C. E. L. B. Davis, 1892. Report, **92**, 1045.

Lt. Col. C. J. Allen, 1900–. Reports, **1900**, 1743, 1745.

ASSISTANT. H. Bacon. Report, **75**, ii, 109.

**Estimates.** (See *Plans* and *Projects*.

By H. Bacon, concurred in by Maj. Craighill, channel 150 f. by 9 f., $30,000; channel 150 f. by 8 f., $19,000; channel 100 f. by 9 f., $21,000; channel 100 f. by 8 f., $13,000, **75**, ii, 108, 109. First adopted by Mr. Abert, **78**, 513.

By S. T. Abert, 1879, to complete existing project, $21,000, **79**, 601.

**Operations.**

**1878–79.** Channel dredged 60 f. by 9 f. through the shallowest water and a basin for turning steamers at the wharf, **79**, 83, 600.

**1879–80.** 21,600 c. y. dredged from basin and channel, **80**, 756.

**1880–81.** 17,976 c. y. dredged from channel and basin, **81**, 950.

**1881–82.** 16,256 c. y. dredged from basin, **82**, 1011.

**1882–83.** 22,048 c. y. dredged from channel and basin, **83**, 798.

**1884–85.** 20,359 c. y. dredged from channel and basin, **85**, 964.

**1886–87.** 40,930 c. y. dredged, **87**, 930.

**1888–89.** 13,141 c. y. dredged, **89**, 1001.

**1890–91.** Dredging in progress under contract, **91**, 1258.

**1891–92.** 28,800 c. y. dredged, **92**, 1046.

**Physical characteristics.**

Description of, **75**, ii, 109; **78**, 513; **1900**, 1745.

**Plans.** (See *Estimates* and *Projects*.)

By H. Bacon, dredging a channel 8 f. or 9 f. in depth and 100 f. or 150 f. in width and a basin for turning steamers, **75**, ii, 108, 110.

**Projects.** (See *Estimates* and *Plans*.)

By S. T. Abert, dredging a channel 150 f. by 9 f. and a basin for turning steamers at the wharf, **75**, 513; **79**, 600.

## BRETON BAY, MD. (Leonardtown Harbor)—Continued.

By Lt. Col. Craighill, 1875, dredged channel 150 f. wide and 9 f. deep from Breton Bay to Leonardtown wharf; estimate, $30,000, **75**, ii, 108; **80**, 757. After an expenditure of $23,000 S. T. Abert proposed in 1885 an amended project, whereby the channel was to be widened to 200 f., the basin and channel to be not less than 10 f. deep; estimate, $26,000, **85**, 965. In 1890 the original project was resumed, a width of 150 f. and depth of 9 f. being deemed sufficient to furnish all the facilities required by existing navigation, **91**, 1258; **92**, 1045.

Lt. Col. Allen estimated, 1899, it would cost $36,480 to improve channel in bay, **1900**, 1746.

### Surveys.

By H. Bacon, 1874, under direction of Maj. Craighill. Report, **75**, ii, 108, 109.

Examination and survey ordered by act of Mar. 3, 1899, made 1899 by Lt. Col. Allen (report favorable) (see *Projects*), **1900**, 1743, 1745.

MAPS. **87**, 930; **89**, 1002.

## BRIDGEPORT HARBOR, CONN.[a]

### Appropriations.

| | | |
|---|---|---|
| 1836, | $10,000, | **66**, iii, 29; **71**, 788. |
| 1852, | 10,000, | **66**, iii, 29. |
| 1871, | 20,000, | **71**, 86. |
| 1872, | 40,000, | **72**, 84. |
| 1873, | 30,000, | **73**, 92. |
| 1874, | 20,000, | **74**, 102. |
| 1875, | 15,000, | **75**, 105. |
| 1876, | 10,000, | **76**, 53. |
| 1878, | 10,000, | **78**, 53. |
| 1879, | 10,000, | **79**, 59. |
| 1880, | 10,000, | **80**, 463. |
| 1881, | 10,000, | **81**, 604. |
| 1882, | 10,000, | **82**, 619. |
| 1884, | 5,000, | **84**, 652. |
| 1886, | 20,000, | **86**, 645. |
| 1888, | 10,000, | **88**, 557. |
| 1890, | 20,000, | **90**, 639. |
| 1892, | 20,000, | **92**, 688. |
| 1894, | 10,000, | **95**, 795. |
| 1896, | 28,000, | **96**, 709. |
| 1899, | 50,000, | **99**, 1169. |
| 1900, | 50,000, | **1900**, 1340. |
| Total, | 418,000 | |

### Commerce.

Obstructions to commerce, **66**, iii, 20; iv, 199.

Commercial importance of Bridgeport, Conn., **71**, 797; **74**, ii, 267; **79**, 350.

Prospective increase in business consequent upon improvement, **89**, 697, 700.

Description of, **99**, 1176.

### Contracts.

**1836.** Holmes & Randall, dredging, **79**, 351.

**1853.** S. N. Payne, dredging 27,649 c. y., 30 cents, **79**, 351.

**1871.** F. H. Smith, dredging 24,494 c. y., 23$\frac{4}{10}$ cents. C. C. Campbell, riprapping. **71**, 788.

**1872.** D. V. Howell, riprapping. S. F. Shelbourne, dredging 28,058[b] c. y., 21⅞ cents. **72**, 900.

**1873.** H. N. & A. J. Beardsley, dredging 165,751 c. y., 18 cents, **74**, ii, 267.

**1874.** E. R. Seward,[c] dredging 145,343 c. y., 14½ cents, **75**, ii, 258.

**1875.** E. R. Seward, dredging 100,264 c. y., 12¾ cents, **75**, ii, 259; **76**, 228.

**1877.** H. N. & A. J. Beardsley, dredging 85,603 c. y., 8⅞ cents, **77**, 217; **78**, 405.

**1878.** G. C. Fobes & Co., dredging 85,027 c. y., 10 and 14 cents, **79**, 351.

**1879.** H. N. & A. J. Beardsley, dredging, 15 cents per c. y., **80**, 462.

**1880.** H. N. & A. J. Beardsley, dredging, 10 and 20 cents per c. y., **81**, 603.

**1881.** H. N. & A. J. Beardsley, dredging, 10 cents per c. y., **81**, 604.

**1882.** H. Du Bois & Sons, dredging, 9¼ cents per c. y., **83**, 521.

**1885.** H. Du Bois & Sons, dredging, 7½ cents per c. y., **85**, 651.

**1886.** A. J. Beardsley & Co., dredging, 5$\frac{9}{10}$ cents per c. y., **87**, 612.

**1888.** C. Du Bois and H. N. Du Bois, dredging, 14 cents per c. y., **88**, 558.

**1889.** A. J. Beardsley & Son, dredging, 18 cents per c. y., **89**, 697.

**1891.** Brown & Fleming, stone breakwater, $1.29 per ton, **91**, 782. G. B. Beardsley, dredging, 14.6 cents per c. y. **91**, 783.

**1892.** A. J. Beardsley, dredging, 9¼ cents per c. y., s. m. ($19,000), **93**, 941.

**1894.** A. J. Beardsley, dredging, 69,565 c. y., 11½ cents per c. y., **95**, 795.

**1896.** G. B. Beardsley, dredging, 10 cents per c. y. ($14,000), **97**, 960.

**1898.** H. Du Bois' Sons, dredging, 6$\frac{9}{10}$ cents per c. y. ($5,520), **99**, 1170, 1171.

**1899.** Hughes Bros. & Bangs, dredging, 5 cents per c. y.; stonework, $2 per long ton ($151,325), **99**, 1171.

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[a] Survey.—Report, Sept. 26, 1838; estimate, $52,800, and Dec. 11, 1852, estimate, $10,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Given as 28,303 c. y., **74**, ii, 266; as 45,518 (5,313+11,902+28,303), **79**, 352.

[c] Contract extended, **75**, ii, 258; **76**, ii, 228.

## BRIDGEPORT HARBOR, CONN.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7, ii, 41, iii, 19: **68**, 68; **69**, 58; **70**, 31, 76; **71**, 85; **72**, 83; **73**, 92; **74**, 102; **75**, 105; **76**, 53; **77**, 47; **78**, 53; **79**, 59; **80**, 79; **81**, 94; **82**, 95; **83**, 90; **84**, 97; **85**, 85; **86**, 86; **87**, 49; **88**, 50; **89**, 63; **90**, 56; **91**, 70; **92**, 74; **93**, 80; **94**, 71; **95**, 80; **96**, 77, 102; **97**, 23; **98**, 99; **99**, 112, 124; **1900**, 129.

ENGINEERS IN CHARGE:

Capt. W. H. Swift, 1838, **71**, 788.

Capt. George Dutton, 1852, **71**, 789.

Capt. D. C. Houston, 1866–70, **66**, ii, 41. Reports, **66**, iv, 199; **68**, 750; **69**, 410, 412.

Maj. G. K. Warren, 1870–75, **70**, 74. Reports, **70**, 453; **71**, 786; **72**, 895; **73**, 1019; **74**, ii, 265.

Maj. J. W. Barlow, 1875–83. Reports, **75**, ii, 258; **76**, 227; **77**, 217; **78**, 404; **79**, 349; **80**, 462; **81**, 603; **82**, 617.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 520; **84**, 652; **85**, 651.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 644; **87**, 610; (Col.), **88**, 555; **89**, 693, 698, 700; **90**, 637; **91**, 778; **92**, 685.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 937; **94**, 659; (Col.), **95**, 791.

Maj. H. M. Adams, 1896. Reports, **96**, 707, 803.

Maj. S. S. Leach, 1897-. Reports, **97**, 959; **98**, 961; **99**, 1168, 1173, 1187; **1900**, 1339.

ASSISTANTS:

S. Simons, **79**, 351.

G. Beckwith. Report, **66**, iv, 201.

Capt. A. H. Holgate. Report, **69**, 413.

W. S. Edwards, **71**, 787; **72**, 896.

W. W. Starr, jr., **73**, 1021. Reports, **74**, ii, 266; **75**, ii, 260; **76**, 228.

**Estimates.** (See also *Plans* and *Projects.*)

By S. Simons, 1838, dredging through outer and inner bars, $52,800, **79**, 351.

By Maj. Warren, widening channel to 200 feet, $72,000 in addition to original estimate, **71**, 796. For a breakwater, $371,000 to $567,000, **71**, 794 *et seq.*

By W. W. Starr, jr., widening channel and constructing jetty, $126,050, **74**, ii, 268. Deepening channel, $16,442.75 to $147,673, **75**, ii, 260. Modified estimates, $25,017.30 to $45,757.90, **76**, 228.

**Obstructions.**

List of bridges crossing the harbor, **96**, 707; **99**, 1189.

Plans of the city of Bridgeport for drawbridge over Yellow Mill Cove approved, **98**, 962.

**Operations.**

**1837–38.** Channel 60 feet wide and 8 feet deep dredged across outer bar, **70**, 453; **71**, 788; **79**, 351.

**1853–54.** 27,649 c. y. dredged, **71**, 789; **79**, 351.

**1871–72.** 521 l. f. jetty extension, 24,494 c. y. dredged, **72**, 83, 896.

**1872–73.** 859 l. f. jetty extension, 28,058 c. y. dredged, **73**, 92, 1020.

**1873–74.** 165,751 c. y. dredged; one wreck removed, **74**, 102, ii, 265, 266.

**1874–75.** 126,671 c. y. dredged, **75**, ii, 258, 260.

**1875–76.** 118,936 c. y. dredged, **76**, 228.

**1877–78.** 85,603 c. y. dredged, **78**, 404; **79**, 353.

**1878–79.** 85,027 c. y. dredged, **79**, 59, 349.

**1879–80.** 89,417 c. y. dredged, **80**, 462.

**1880–81.** 70,703 c. y. dredged, **81**, 604.

**1881–82.** 90,000 c. y. dredged, **82**, 618.

**1882–83.** 90,561 c. y. dredged, **83**, 520.

**1884–85.** 59,352 c. y. dredged, **85**, 651.

**1886–87.** 261,960 c. y. dredged, **87**, 610.

**1887–88.** 14,000 c. y. dredged, increasing depth over shoal to 12 feet mean low water, **88**, 556.

**1888–89.** 34,051 c. y. dredged, **89**, 695.

**1889–90.** 10,946 c. y. dredged, **90**, 638.

**1890–91.** 750 tons riprap placed in breakwater, completing 300 l. f. of the same, **91**, 781.

**1891–92.** 9,077 tons riprap placed in breakwater; 30,000 c. y. dredged, **92**, 687.

**1892–93.** 190,132 c. y. dredged, **93**, 939.

**1894–95.** 48,456 c. y. dredged, **95**, 794.

**1895–96.** 21,523 c. y. dredged, **96**, 708.

**1897–98.** 137,700 c. y. dredged, **98**, 962.

**1898–99.** A channel 200 f. wide. and 12 f. deep, m. l. w., dredged from the main channel of the harbor to a point 50 f. below Yellow Mill Bridge, **99**, 1169.

**Physical characteristics.**

Tides **66**, iii, 20, iv, 199; **69**, 414, 415; **79**, 350.

Shores of Long Island Sound described, **71**, 791; **72**, 897.

Description of, **88**, 555; **93**, 937; **96**, 804.

**Plans.** (See *Estimates* and *Projects.*)

By S. Simons, 1838, dredging a channel 200 f. wide and 8 f. deep through outer and inner bars, **79**, 351.

## BRIDGEPORT HARBOR, CONN.—Continued.

By Capt. Houston, construction of a breakwater, **66**, iv, 201.

By Capt. Holgate, construction of 6 piers of loose stone, to prevent further growth of sand spit, **69**, 415.

By Maj. Warren, breakwater 1,200 y. long, 11 f. high, 6 f. wide on top, the body of breakwater to be of solid masonry resting upon a bed formed by large blocks of stone and protected by riprap, **71**, 794.

By W. W. Starr, jr.: 1st, for dredging a 500-f. channel through outer bar, 600-f. channel through inner bar, 500-f. channel between inner beacon and Naugatuck pier, and 20,000 c. y. at Flat Iron; also for extension of jetty; 2d, for deepening channels to 12 or 15 f. with a width of 100, 200, or 300 f.; 3d, see *Projects*, **74**, ii, 268; **75**, ii, 260; **76**, 228.

**Projects.** (See *Estimates* and *Plans.*)

By Capt. Swift, 1838, dredging a channel 60 f. wide and 8 f. deep, across outer bar, **71**, 788.

By Capt. Dutton, 1853, dredging a channel 200 f. wide and 8 f. deep, estimate originally $22,000, subsequently reduced to $14,000, **71**, 789.

By Maj. Warren, dredging channel 100 f. wide and 14 f. deep through outer and inner bars; sea wall of a row of dolphins 2,600 f. long, built in groups of 5 piles 8 f. apart; also dry wall of split granite 400 f. long; estimate, $124,000, **71**, 86, 787, 791, 796; **79**, 352.

By Maj. Barlow, deepening channel to 12 f. with a width of 100 f.; estimate, $16,442.75, **75**, ii, 260. Widening 12-f. channel to 300 f.; estimate, $25,200, **78**, 53, 404; **79**, 350.

The projects of 1871–75 proposed the formation of a channel of navigable width and 12 f. deep from Long Island Sound to the lower bridge; estimate, $138,000 for dredging; also a riprap jetty 1,380 f. long from Long Beach; estimate, $35,000, **80**, 462. Work completed in 1880 under aggregate appropriations amounting to $195,000, when Maj. Barlow proposed the widening to 600 f. of the channel from the inner beacon to the steamboat wharf; estimate, $60,000. **81**, 604; **85**, 651; **86**, 644; **87**, 610.

By Col. Houston, 1887, dredging to 12 f., m. l. w. the channel from the Naugatuck R. R. wharf up to the lower bridge; also for increasing the width of the channel to 600 f.; estimate, $17,000, **88**, 557. In 1889 Col. Houston modified and extended his project: (1) Completion of a channel 12 f. deep at m. l. w. and 300 f. wide, Long Island Sound to the lower bridge; estimate, $17,000; (2) completion of a channel 9 f. deep and 100 f. wide from the lower bridge to the head of the harbor; estimate, $8,000; (3) breakwater extending from a point called The Tongue in the western side of the harbor entrance, southeast to the inner beacon; estimate, $30,000. Total estimate cost of project, $55,000, with an annual expenditure for maintenance of dredged channels of $3,000, **89**, 696; **90**, 637, 638.

History of projects, **91**, 779.

In 1892 Col. Houston proposed to complete the channels above the bridges, to remove the shoal places above the Naugatuck R. R. wharf, and to widen the channel eastward to the harbor lines an additional width of about 200 f.; also to complete the breakwater from The Tongue to the inner beacon; estimate, $35,000, **92**, 688.

By Lt. Col. Robert, 1894, for a channel 100 f. wide and 15 f. deep through the outer bar, **95**, 793.

By Maj. Adams, 1895, for extending the 15-f. channel to the lower bridge, making it 300 f. wide up to the inner beacon and 200 f. wide above that beacon, which, with the uncompleted work of the then existing project, was estimated to cost $90,000, **96**, 707.

By Maj. Leach, 1897, for widening to 200 f. the 15-f. channel on its east side from the sound to the outer beacon, a distance of about 4,700 f., and for extending the channel from the bar to the inner beacon, a distance of about 1,300 f., with a width of from 60 to 100 f., **97**, 959. Modified, **98**, 962,

By Maj. Leach, 1898, for (1) dredging a main channel 18 f. deep, 300 f. wide south of the inner beacon and 200 f. wide north of it; 3 anchorage basins; channels 12 f. deep, 100 f. wide, and 1 mile long each in Poquonnock River and Yellow Mill Cove; channels 9 f. deep, 100 f. wide, and three-fourths, one-eighth, and one-half mile long in Johnsons, Cedar, and Burr creeks, respectively; (2) repair and maintenance of the four breakwaters already built, and construction and maintenance of shore protection on Fayerweather Island; estimate, $300,000, **99**, 1175; **1900**, 1339.

Maj. Leach estimated, 1899, it would cost $175,000 to extend and widen harbor channel in accordance with a plan of Congress, which plan Maj. Leach did not consider most suitable for the needs of the harbor, **99**, 1188.

**Surveys.**

By Lt. Blade, U. S. N., 1837, **66**, iv, 199; **71**, 788.

By G. Beckwith, 1866–68, **69**, 413. Report, **66**, iv, 201.

By W. S. Edwards, **71**, 787.

By W. W. Starr, jr., **73**, 1021; **74**, ii, 267.

## BRIDGEPORT HARBOR, CONN.—Continued.

Under direction of Maj. Barlow, 1878, **79**, 349.

Survey ordered by act of Aug. 17, 1894, made in 1895 by Maj. Adams (see *Projects*), **96**, 803.

Harbor lines established by the Secretary of War in 1893, **94**, 661.

Maps. Map of the harbor, **79**, 350; **82**, 618; **85**, 652, **87**, 612; **93**, 940.

## BRIGANTINE BEACH AND INLET, N. J. (channel behind) Absecon and Brigantine Inlets. (See *Absecon Inlet.*)

**Commerce.**
Small.

**Engineers.**
Chief of Engineers. Report, '**87**, 86.
Engineer in Charge. Lt. Col. H. M. Robert, 1886. Report, **87**, 821.

**Physical characteristics.**
Difficult to keep a channel open, **87**, 821.

**Survey.**
Examination ordered by act of Aug. 5, 1886; made, 1886, under direction of Lt. Col. Robert (report unfavorable), **87**, 821.

## BROAD AND SALUDA RIVERS, ABOVE COLUMBIA, S. C.

**Engineers.**
Chief of Engineers. Report, **89**, 158.
Engineer in Charge. Capt. F. V. Abbot. Report, **89**, 1203.

**Physical characteristics.**
Descriptions of, **89**, 1203.

**Survey.**
Examination ordered by act of Aug. 11, 1888; made, 1888, under direction of Capt Abbot (report unfavorable), **89**, 1203.

## BROAD BAY. (See *Lynn Haven Bay, Va.*)

## BROAD CREEK, MD.

**Engineers.**
Chief of Engineers. Reports, **81**, 150; **82**, 144; **91**, 132.
Engineers in Charge:
Lt. Col. W. P. Craighill. Report, **82**, 948.
Maj. W. F. Smith, U. S. agent. Reports, **91**, 1221, 1223.
Assistant. A. Stierle. Reports, **91**, 1222, 1224.

**Physical characteristics.**
Description of, **91**, 1222.

**Plans.**
By Col. Craighill, 1882, dredged channel 8 f. deep at m. l. w. and 150 f. wide on the west side of Kent Island; also an interior basin 800 f. square; estimate, $60,000, **82**, 948.

By Maj. Smith, 1891, excavation of a 7-f. low-water channel 120 f. in width, from the 7-f. depth in Pocomoke Sound to the same depth in Little Annemessex River, removing 270,000 c. y.; estimate, $54,000, **91**, 1223.

**Surveys.**
Examination ordered by act of Mar. 3, 1881, made under the direction of Col. Craighill, **82**, 948.

Ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Smith, **91**, 1223.

## BROAD CREEK RIVER, DEL. (See *Nanticoke River, Del.*)

**Appropriations.**

| | | | | |
|---|---|---|---|---|
| 1880, | $5,000, | **80**, | 643. | |
| 1881, | 10,000, | **81**, | 886. | |
| 1882, | 5,000, | **82**, | 858. | |
| 1886, | [a]10,000, | **87**, | 844. | |
| 1888, | 5,000, | **88**, | 750. | |
| 1892, | 5,000, | **93**, | 1221. | |
| 1894, | 5,000, | **95**, | 1139. | (See *Projects.*) |
| 1896, | 5,000, | **96**, | 967. | |
| 1899, | 5,000, | **99**, | 1390. | |
| Total, | 55,000 | | | |

**Commerce.**
Important, **80**, 642; **81**, 885; **85**, 880.
Beneficial effects of improvement, **91**, 1210.

**Contracts.**
**1881.** G. W. Parsons, dredging, 23$\frac{3}{4}$ cents per c. y., **81**, 887.
**1889.** F. C. Somers, dredging, 20 cents per c. y., **89**, 894.
**1892.** C. T. Caler, dredging, 9$\frac{9}{10}$ cents per c. y., p. m., **93**, 1221.
**1895.** Baltimore Dredging Co.,

[a] **Improving Nanticoke River, Del., 87, 843.**

## BROAD CREEK RIVER, DEL.—Continued.

dredging, $19\frac{8}{10}$ cents per c. y., p. m., **95**, 1140.

**1896.** C. T. Caler, dredging, $9\frac{1}{2}$ cents per c. y., p. m., **97**, 1280.

**1899.** Baltimore Dredging Co., dredging, $12\frac{4}{10}$ cents per c. y., p. m., **1900**, 1654.

**Engineers.**

Chief of Engineers. Reports, **80**, 103, 110; **81**, 139; **82**, 135; **83**, 138; **84**, 145; **85**, 130; **86**, 128; **87**, 95; **88**, 94; **89**, 107; **90**, 98; **91**, 131; **93**, 140; **94**, 128; **95**, 146; **96**, 133; **97**, 167; **98**, 170; **99**, 196; **1900**, 225.

Engineers in Charge:

Lt. Col. W. P. Craighill, 1880–85. Reports, **80**, 640; **81**, 885; **82**, 857; **83**, 680; **84**, 903.

W. F. Smith, U. S. Agent, 1885–. Reports, **85**, 880; **86**, 863; **87**, 843; **88**, 750; (Maj.) **89**, 894; **90**, 933; **91**, 1209; **93**, 1220; **94**, 897; **95**, 1138; **96**, 966; **97**, 1278; **98**, 1164; **99**, 1389; **1900**, 1653.

Assistants:

J. L. Seager, **80**, 640.

G. W. Pearsons. Report, **81**, 887.

A. Stierle. Report, **91**, 1209.

**Operations.**

**1880–82.** Cut dredged about 7,000 f. long and 32 f. wide, **82**, 857.

**1882–83.** Continuation of dredging, **83**, 680.

**1889–90.** 19,987 c. y. dredged, **90**, 933.

**1892–93.** 43,997 c. y., p. m., dredged, **93**, 1221.

**1895–96.** 19,986 c. y., p. m., dredged from toward the mouth of Nanticoke River, **96**, 967.

**1898–99.** 39,981 c. y. dredged, **99**, 1389.

**1899–1900.** 30,307 c. y. dredged, **1900**, 1653.

**Physical characteristics.**

Described, **80**, 641.

A tributary of the East Fork of Nanticoke River, **1900**, 225.

**Projects.**

By Lt. Col. Craighill, 1880, channel 60 f. wide and 7 f. deep by dredging, mouth to Laurel, supplemented by wing dams and training walls; estimate $60,000, **80**, 641.

In 1883 Col. Craighill reported, after an aggregate appropriation of $20,000, that further dredging without training works would be useless, and estimated that $32,625 would be required to complete the project involving such works, **83**, 681.

In 1891 Maj. Smith, U. S. agt., proposed the excavation of channel, Laurel to Bethel, Del., to a width of 70 f. and a depth of 8 f. at m. l. w.; estimate $15,000, **91**, 1210.

Congress directed in 1894 that as much of the appropriation of $5,000 made in that year as necessary should be used to remove the bar extending from the railroad bridge at Seaford toward the mouth of the Nanticoke River. As this was not in the project for the improvement of Broad Creek River, and the cost of removing the bar would exceed $5,000, it was determined to use this amount as far as it would go in removing the bar by dredging the existing channel to a depth of 9 f. below m. l. w. and about 50 f. wide from Seaford to deep water below. **95**, 1139.

**Surveys.**

Ordered by act of Mar. 3, 1879, **79**, 81; **80**, 110; made under direction of Lt. Col. Craighill, 1880, **80**, 640.

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. W. F. Smith, **91**, 1209.

Examination made, 1900, by Maj. Smith, **1900**, 1653.

Maps. **91**, 1210.

## BROADKILL CREEK, DEL.

(See *Cedar Creek, Del.; Mispillion River.*)

**Appropriations.**

| | | |
|---|---|---|
| 1873, | $10,000, | **73**, 82, 871. |
| 1880, | 5,000, | **80**, 587. |
| 1881, | 5,000, | **81**, 780. |
| 1882, | 5,000, | **82**, 768. |
| 1888, | 10,000, | **88**, 744. |
| Total, | 35,000 | |

**Commerce.**

Description of, **93**, 1233; **95**, 1153.

Tonnage of craft using the river, 1895, 1,523 tons, **95**, 1153.

**Contracts.**

**1874.** American Dredging Co., dredging, 30 cents per c. y., **74**, ii, 143.

**1885.** American Dredging Co., dredging, 12 cents per c. y., **86**, 863.

**1889.** American Dredging Co., dredging, 7 cents per c. y., **90**, 929.

**Engineers.**

Chief of Engineers. Reports, **72**, 78, 792, 793; **73**, 82; **74**, 93; **75**, 99; **76**, 61; **77**, 55; **78**, 62; **79**, 73; **80**, 95; **81**, 122; **82**, 121; **83**, 121; **84**, 130; **85**, 130; **86**, 128; **87**, 90; **88**, 90; **89**, 105; **90**, 96; **91**, 122; **92**, 123; **93**, 133, 143; **94**, 123; **95**, 139, 150; **97**, 162; **98**, 166; **99**, 190; **1900**, 216.

Engineers in Charge:

Lt. Col. J. D. Kurtz, 1871. Reports,

## BROADKILL CREEK, DEL.—Continued.

**72,** 792, 797; **73,** 871; **74,** ii, 142; **75,** ii, 194; **76,** 276; **77,** 268.

Capt. W. Ludlow, 1877, **78,** 431.

Col. J. N. Macomb, 1878–81. Reports, **78,** 441; **79,** 445; **80,** 587; **81,** 780, 782.

Capt. W. Ludlow, 1881–82. Report, **82,** 768.

Lt. Col. G. Weitzel, 1882–84. Report, **83,** 623.

Maj. W. H. Heuer, 1884–85. Report, **84,** 828.

W. F. Smith, U. S. Agent, 1885. Reports, **85,** 879; **86,** 863; **87,** 834; **88,** 744; (Maj.) **89,** 890; **90,** 928; **91,** 1167; **92,** 955; **93,** 1203, 1231; **94,** 883; **95,** 1122, 1151; **96,** 954; **97,** 1270; **98,** 1156; **99,** 1380; **1900,** 1641.

Assistants:

Capt. M. R. Brown. Reports, **72,** 793–797; **74,** ii, 143.

J. A. Chase, **72,** 792, 794.

J. H. Odiorne. Report, **83,** 624.

J. M. Stewart. Report, **84,** 828.

A. Stierle. Reports, **93,** 1232; **95,** 1152.

**Operations.**

**1873–74.** Channel 5 f. by 35 f. Milton to Oyster Rock Shoals, near the mouth of the river, dredged, **74,** 93; ii, 142.

**1885–86.** 92,737 c. y. dredged, mouth to Milton, Del., **86,** 862.

**1889–90.** 20,972 c. y. dredged, **90,** 928.

**1890–91.** 104,284 c. y. dredged, **91,** 1167.

**Physical characteristics.**

Description of. **72,** 792–797; **93,** 1232.

Description of the mouth. **95,** 1152.

**Private work.**

Canal cut by the citizens of Lewes from Lewes Creek to the old back channel, **72,** 796.

**Projects.**

By Capt. Brown, 6–f. channel from Milton to the mouth by reopening Old Inlet, dredging a cut across the beach, dredging and clearing the river, and building a dam to turn the water from Lewes Sound, **72,** 792, 795.

By Lt. Col. Kurtz, expending appropriation by dredging the river above the drawbridge as far as the money would allow, **73,** 871.

By Col. Macomb, 1881, formation of a river entrance below junction of Lewis and Broadkill creeks, to obtain, by dredging and construction of a deflecting jetty, a channel 6 f. deep at mean low water; estimate, $51,500, **81,** 782; **91,** 1167; **92,** 955.

**Surveys.**

Allotment for survey, $600, **72,** 792.

Under direction of Lt. Col. Kurtz, by Capt. M. R. Brown and James A. Chase. Report, **72,** 792–797.

Examination for an inland waterway to connect Mispillion and Broadkiln rivers so as to reopen the navigation of Cedar, Slaughter, and Primehook creeks, ordered by act of July 13, 1892, made under the direction of Maj. Smith, 1892 (report unfavorable), **93,** 1231.

Examination of the mouth ordered by act of Aug. 17, 1894, made under the direction of Maj. Smith, 1894 (report unfavorable), **95,** 1151.

## BROADKILN RIVER. (See *Broadkill Creek, Del.; Cedar Creek Del.*)

## BROAD LYNN HAVEN AND LINK HORN BAYS, VA.

**Engineers.**

Chief of Engineers. Report, **80,** 125.

Engineer in Charge. Capt. C. B. Phillips. Report, **80,** 900.

Assistant. F. W. Frost. Report, **80,** 901.

**Physical characteristics.**

Described, **80,** 901.

**Plans.**

Useless to attempt to improve the interior bays unless the project should include improving entrance to Lynn Haven Bay, which would be too expensive, **80,** 901.

**Survey.**

Ordered by act of Mar. 3, 1879, **80,** 125; made under direction of Capt. Phillips, 1879 (see *Plans*), **80,** 900.

## BROAD RIVER, N. C. AND S. C.

**Commerce.**

Unimportant, **80,** 1011, 1013, 1026.

**Engineers.**

Chief of Engineers. Reports, **80,** 132; **84,** 177.

Engineers in Charge:

Lt. Col. G. A. Gillmore. Report, **80,** 1010.

Capt. J. Mercur. Report, **84,** 1058.

Assistant. J. P. Carson. Report, **80,** 1013.

**Physical characteristics.**

Described, **80,** 1014.

The head of navigation is 28 miles above the N. C. and S. C. boundary line, **80,** 1014.

## BROAD RIVER, N. C. AND S. C.—Continued.

**Plans.**

By Col. Gillmore, 1880, for channel for pole-boat navigation. Estimate, $90,000, **80**, 1013.

**Surveys.**

Examination from mouth near Columbia, S. C., 141 miles upward, ordered by act of Mar. 3, 1879, **80**, 132; made under direction of Col. Gillmore, 1880, **79**, 100; **80**, 1010.

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Mercur (report unfavorable), **84**, 1058.

## BRONX RIVER, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $10,000, | **96**, 734. |
| 1899, | 20,000, | **99**, 1218. |
| Total, | 30,000 | |

**Contracts.**

**1896.** F. Pidgeon, rock removal, $6.89 per c. y. ($9,000), **97**, 1095.

**1899.** S. F. Randolph, rock removal, $3.78 per c. y. ($16,000), **1900**, 1391.

**Engineers.**

Chief of Engineers. Reports, **80**, 85; **81**, 108; **91**, 94; **96**, 84; **97**, 118; **98**, 114; **99**, 128; **1900**, 146.

Engineers in Charge:

Col. J. Newton. Report, **81**, 665.

Lt. Col. G. L. Gillespie, 1891. Reports, **91**, 949, 951.

Maj. H. M. Adams, 1896–98. Reports, **96**, 733; **97**, 1093; **98**, 999.

Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1217.

Maj. E. H. Ruffner, 1900–. Report, **1900**, 1389.

Assistants. R. H. Talcot. Report, **81**, 666.

G. W. Kuhule. Report, **91**, 953.

**Operations.**

**1896–97.** About 1,100 c. y. rock removed, **97**, 1094.

**1897–98.** About 124 c. y. rock removed, **98**, 1000.

**1899–1900.** 667 c. y. rock removed, **1900**, 1390.

**Physical characteristics.**

Described, **81**, 666; **91**, 949.

**Plans.** (See *Projects.*)

By Col. Newton, 1881, improvement with dredging and dikes to obtain a channel from 30 to 50 f. wide and from 4 to 5 f. deep at m. l. w.; estimate, $136,275, **81**, 666, 667.

**Projects.** (See *Plans.*)

By Lt. Col. Gillespie, 1890, widening and deepening the channel to afford a navigable channel 4 f. deep at m. l. w. and 100 f. wide from the head of the estuary at Strain place to Barlow street, 60 f. wide to Dongan street, and 50 f. wide to West Farms, below the Bronx Co.'s Dye Works. Length of channel, 1¾ miles, involving removing 54,880 c. y.; estimate, $85,985. **91**, 952.

By Lt. Col. Benyaurd, 1899, survey and dredging or rock removal after survey had been platted and the condition of the river more fully understood, **99**, 1218.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 85.

Survey ordered by act of Sept. 19, 1890, made 1891 under direction of Lt. Col. Gillespie, **91**, 951.

Survey made, 1899, by Lt. Col. Benyaurd, **99**, 1218.

## BROOKLYN, ILL. (See *Mississippi River.*)

## BROOK NEAL. (See *Staunton River, Va.*)

## BROWNS CREEK, SAYVILLE, LONG ISLAND, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $12,000, | **91**, 830. |
| 1892, | 5,000, | **92**, 729. |
| 1894, | 4,000, | **95**, 849. |
| 1896, | 4,000, | **96**, 750. |
| 1899, | 3,000, | **99**, 1248. |
| Total, | 28,000 | |

**Commerce.**

Present and prospective commerce of the locality, **90**, 670.

**Contracts.**

**1891.** E. Bailey & Sons, riprap jetty construction, $2.80 per ton, **91**, 830.

**1892.** A. E. Smith, dredging, 34 cents per c. y., p. m. ($5,100), **93**, 989.

**1895.** A. E. Smith, dredging, 15 cents per c. y., p. m. ($3,500), **96**, 750.

**1896.** K. Simon, dredging, 15 cents per c. y., s. m. ($3,500), **97**, 1113.

**1899.** C. Vivian, dredging, 13¾ cents per c. y., p. m. ($2,500), **99**, 1418.

**Engineers.**

Chief of Engineers. Reports, **89**, 71; **90**, 63; **91**, 79; **92**, 83; **93**, 91; **94**, 81; **95**, 92; **96**, 89; **97**, 124; **98**, 119; **99**, 140; **1900**, 157.

## BROWNS CREEK, SAYVILLE, LONG ISLAND, N. Y.—Continued.

ENGINEERS IN CHARGE:
Col. D. C. Houston, 1888–92. Reports, **90**, 669; **91**, 828; **92**, 727.
Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 986; **94**, 708; (Col.), **95**, 847.
Maj. H. M. Adams, 1896–98. Reports, **96**, 748; **97**, 1111; **98**, 1012.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1247.
Maj. E. H. Ruffner, 1900–. Report, **1900**, 1417.

ASSISTANT. Lt. J. C. Sanford. Report, **90**, 669.

**Operations.**
**1891–92.** 492 l. f. of west jetty and 275 l. f. of east jetty completed, **92**, 728.
**1892–93.** 273 tons stone deposited in east jetty and 12,000 c. y., p. m., dredged, **93**, 988.
**1895–96.** 17,903 c. y., p. m., dredged, **96**, 749.
**1896–98.** In connection with previous year, 24,279 c. y., p. m., dredged, **97**, 1112; **98**, 1013.
**1899–1900.** 15,727 c. y. dredged, **1900**, 1417.

**Physical characteristics.**
Description of, **90**, 669.

**Projects.**
By Col. Houston, 1889, channel 100 f. wide and 6 f. deep at m. l. w. from the 6-foot curve in the bay up to the first bend in the creek, 1,850 f.; estimate, $46,000, **90**, 673; **92**, 728.

**Surveys.**
Ordered by act of Aug. 11, 1888; made, 1889, under direction of Col. Houston, **90**, 673.
MAPS. **94**, 710.

**BROWNSVILLE.** (See *Monongahela River.*)

**BROWNVILLE, NEBR.** (See *Missouri River between mouth and Sioux City.*)

**BRUNSWICK, GA.** (See *Mississippi River.*)

**BRUNSWICK, MO.** (See *Grand River, Mo.; Missouri River between mouth and Sioux City.*)

**BRUNSWICK CANAL AND HARBOR, ME.**[a] (See *Androscoggin River.*)

## BRUNSWICK HARBOR, GA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1836, | $10,000, | **79**, | 765. |
| 1879, | 20,000, | **79**, | 98. |
| 1880, | 10,000, | **80**, | 963. |
| 1881, | 5,000, | **81**, | 1115. |
| 1882, | 25,000, | **82**, | 1182. |
| 1884, | 10,000, | **84**, | 1120. |
| 1886, | 22,500, | **86**, | 1116. |
| 1888, | 35,000, | **88**, | 1047. |
| 1890, | 35,000, | **90**, | 1407. |
| 1892, | 27,500, | **92**, | 1282. |
| 1894, | 10,000, | **95**, | 1493. |
| 1896, | 15,000, | **96**, | 1276. |
| 1899, | 10,000, | **99**, | 1587. |
| Total, | 235,000 | | |

**Commerce.**
Commercial facilities of Brunswick, Ga., **76**, 488.
Importance of improvement, **81**, 1115, 1118; **83**, 926; **86**, 1115; **87**, 1186.
Increase in business from 1880 to 1890, **90**, 1406.
Description of, **96**, 1276; **97**, 1523; **98**, 1314.
In 1892 it was valued at $13,652,703, **93**, 1581; in 1893, at $8,978,485, **94**, 1190.
Commerce important, and increasing, **1900**, 1962.

**Contracts.**
**1880.** J. Brady, jetty. J. E. Walter, dredging, 13⅞ cents per c. y. **80**, 963.
**1881.** J. E. Walter, dredging, 24½ cents and 33½ cents per c. y., **81**, 1116.
**1882.** J. E. Walter, dredging, 27 cents per c. y. J. C. Provost, jetty, **83**, 922, 923.
**1884.** J. S. Howell, jetty, **85**, 1225.
**1888.** P. S. Ross, dredging, 21 cents per c. y., **89**, 1267.
**1889.** C. C. Ely, training wall, $13,215, **89**, 1267.
**1891.** J. F. Gaynor, training wall, $21,270, **91**, 1554. P. S. Ross, dredging, 24½ cents per c. y., **91**, 1554.
**1893.** P. S. Ross, dredging, 25 cents per c. y. ($6,000), **93**, 1582. Atlantic Contracting Co., fascines, $1.67 per c. y.; riprap stone, $3.69 per c. y. ($18,000), **93**, 1583.
**1896.** R. R. Moore, dredging, 14 cents per c. y. ($8,400), **97**, 1524.
**1899.** P. S. Ross (incorp.), dredging, $13\frac{7}{10}$ cents per c. y. ($8,905), **1900**, 1950.

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[a] Survey.—Report, Feb. 18, 1828. (H. Doc. No. 482, 55th Cong., 2d sess.)

## BRUNSWICK HARBOR, GA.—Continued.

**Defense.**
Importance of harbor in maritime warfare, **76**, 488.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **76**, 71; **79**, 98; **80**, 129; **81**, 175; **82**, 170; **83**, 180; **84**, 188; **85**, 188; **86**, 187; **87**, 151; **88**, 142; **89**, 162, 367; **90**, 146; **91**, 182, 185; **92**, 179; **93**, 196; **94**, 180; **95**, 204; **96**, 183; **97**, 233; **98**, 229; **99**, 264, 267; **1900**, 302.

BOARDS OF ENGINEERS.
Commission appointed, 1836, by U. S. Senate "to survey and examine ports south of the Chesapeake, with a view to their comparative facilities and advantages for a navy-yard," reported that out of six harbors examined Brunswick Harbor was to be preferred for a navy-yard on account of its "depth of water, easy access, and capability of defense." Report (extract), **76**, 488. (Commodores Wolsey, Claxton, and Shubrick, commissioners.)

Convened at Savannah, Ga., April 1, 1889, by S. O. No. 30, to establish harbor lines in Brunswick Harbor. Report, **89**, 1293. (Capt. Bixby and Lt. Carter.)

ENGINEERS IN CHARGE:
Lt. Col. Q. A. Gillmore, 1876–92, **76**, 71. Reports, **76**, 486; **79**, 765; (Col.), **80**, 959; **81**, 1112; **82**, 1178; **83**, 919; **84**, 1118; **85**, 1224; **86**, 1112; **87**, 1184.

Lt. O. M. Carter, 1886–97. Reports, **88**, 1044; **89**, 1263, 1292; **90**, 1404; **91**, 1550; **92**, 1278; (Capt.), **93**, 1578; **94**, 1187; **95**, 1490; **96**, 1273; **97**, 1521.

Capt. C. E. Gillette, 1898–. Reports, **98**, 1313; **99**, 1585; **1900**, 1948, 1962, 1964.

ASSISTANTS:
S. L. Tremont. Reports, **80**, 964; **81**, 1116.
Lt. T. N. Bailey. Report, **83**, 923.
W. R. Curtis. Report, **85**, 1227.
Lt. O. M. Carter. Report, **86**, 1116; **87**, 1188.
M. P. Paret. Report, **89**, 1267.
E. A. Gieseler. Report, **95**, 1495.

**Operations.**
**1879–80.** Jetty commenced; 1,848 c. y. dredged from shoal, **80**, 961.
**1880–81.** 830 l. f. of jetty built, 34,160 c. y. dredged, **81**, 1113.
**1881–82.** 1,319 l. f. jetty built, 16,016 c. y. dredged, **82**, 1179.
**1882–83.** 2,405 l. f. jetty built, 28,484 c. y. dredged, **83**, 920, 923.
**1884–85.** Strengthening and raising the upper end of jetty by the use of 6,752 s. y. of mattresses and 990 c. y. of stone, **85**, 1226.
**1886–87.** 40,000 c. y. dredged from East River channel, 9,674 s. y. of mattresses and 1,448 c. y. of stone placed in jetty, **87**, 1186, 1189.
**1888–89.** 50,796 c. y. dredged; 2,319 c. y. of fascines and 369 c. y. of stone placed in training wall, **89**, 1265.
**1889–90.** 29,096 c. y. dredged; 3,714 c. y. brush fascines and 619 c. y. stone placed in training wall, **90**, 1406.
**1890–91.** 1,220 l. f. of jetty built, **91**, 1552.
**1891–92.** 49,324 c. y. dredged, **92**, 1280.
**1892–93.** 29,933 c. y. dredged; 3,868 c. y. fascines and 412 c. y. riprap stone used in jetty work, **93**, 1580.
**1893–94.** 3,332 c. y. fascines and 780 c. y. riprap stone used in jetty work, **94**, 1189.
**1894–95.** 36,079 c. y. dredged; 327 c. y. stone used to fill low places in the jetty, **95**, 1492.
**1896–97.** 59,683 c. y. dredged, **97**, 1523.
**1897–98.** 11,358 c. y. dredged and a wreck removed, **98**, 1314.

**Physical characteristics.**
Comparison with other harbors, **76**, 487.
Description of, **76**, 487; **95**, 1494; **1900**, 1964, 1965.
Tidal observations, **76**, 487; **95**, 1495–1498.
Gauging, **95**, 1496, 1497.

**Plans.** (See *Projects.*)
By Lt. Col. Gillmore, removal of shoal, (1) by construction of gabion jetties, 1,600 f. single tier, 1,500 f. double tier, 300 f. triple tier, 1,800 f. of spur jetty, single tier, estimate, $57,000; (2) by dredging a channel 100 f. wide and 15 f. deep at m. l. w., estimate, $52,500, **76**, 489.

**Projects.**
The project for the improvement of Brunswick Harbor, as proposed by Col. Gillmore in 1880, and modified by him in 1886, had as its object the establishment and maintenance of a 15-f. low-water channel across the shoal in East River. The main features were (1) a training wall projecting from the most easterly point of Buzzards Island to the opposite shore of Blythe Island; (2) a low dam across Turtle River; (3) short spur dams in the lower part of East River; (4) dredging in the vicinity of Truth River Dam, and on the shoal in the lower part of East River. Original estimate, $73,187; as modified, $190,000. **80**, 962; **86**, 1113, 1116; **87**, 1184; **90**, 1404; **91**, 1551; **92**, 1279.

Capt. Gillette estimated, 1899, it would cost $125,700 to raise existing training wall and dredge through shoal in East River to a 21-f. depth, m. l. w., **1900**, 1965.

## BRUNSWICK HARBOR, GA.—Continued.

**Surveys.**

By United States Commission, 1836. (See *Board of Engineers.*)

Examination under direction of Lt. Col. Gillmore, 1875–76. Report, **76**, 486.

Made, 1890, under direction of Lt. Carter, **90**, 1407.

Survey made under direction of Capt. Carter, 1893, **95**, 1494; examination, 1897, **97**, 1523.

Examination and survey of Brunswick, Ga., inner harbor, with a view of determining what improvement would be desirable in the interest of commerce, and cost thereof, ordered by act of March 3, 1899, made, 1899, by Capt. Gillette (report favorable; see *Projects*), **1900**, 1962, 1964.

Maps. **80**, 962; **81**, 1116; **83**, 922; **85**, 1228; **86**, 1116; **87**, 1196; **88**, 1046; **89**, 1266; **92**, Atlas, 58; **93**, 1582; **95**, 1500; **99**, 1586.

## BRUNSWICK OUTER BAR, GA. (See *Brunswick Harbor, Ga.*)

**Appropriation.**[a]

1894, $30,000, **95**, 205.

**Engineers.**

Chief of Engineers. Reports, **93**, 196; **94**, 180; **95**, 205; **96**, 183; **1900**, 306.

Board of Engineers. Convened, Wilmington, N. C., to ascertain and certify as to the depth and width of channel obtained across the outer bar at Brunswick Harbor, Ga., by C. P. Goodyear, by the explosion of dynamite and auxiliary means for smoothing the bottom of the bar channel. Reports, **95**, 1501, 1503; **96**, 1278. (W. W. Duffield, Superintendent Coast and Geodetic Survey, chairman; Maj. W. S. Stanton, Capt. F. V. Abbot.)

Engineer in Charge. Capt. O. M. Carter, 1893–96. Reports, **93**, 1584; **94**, 1193; **95**, 1501; **96**, 1278.

**Physical characteristics.**

Description of, **95**, 1502; **96**, 1279.

**Projects.**

In 1892 Congress provided that C. P. Goodyear should be paid various sums if he should procure, in given periods, a practicable channel over the outer bar at Brunswick, Ga., of various-named depths, by means of dynamite and auxiliary means for smoothing the bottom of the bar channel, **93**, 1585; **96**, 1278.

**Surveys.**

Examinations were made in 1892 and 1893 by Capt. Carter, **93**, 1587; **94**, 1197; by Board of Officers in 1894, 1895, **95**, 1501, 1504; **96**, 1282; all showing that the required widths and depths had not been obtained, as provided by the acts of 1892 and 1894.

## BUCKSHUTEM CREEK, N. J.

**Commerce.**

Not important, **95**, 1097.

**Engineers.**

Chief of Engineers. Report, **95**, 133.

Engineer in Charge. Maj. C. W. Raymond, 1894–95. Report, **95**, 1096.

**Physical characteristics.**

Description of, **95**, 1096.

**Survey.**

Examination ordered by act of Aug. 17, 1894; made by Maj. Raymond, 1894 (report unfavorable), **95**, 1096.

## BUCKHANNON RIVER, W. VA. (See *Taggarts Valley River, W. Va.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1884, | $1,500, | **85**, | 1893. |
| 1886, | 1,500, | **86**, | 1625. |
| 1888, | 1,500, | **88**, | 1795. |
| 1890, | 1,000, | **90**, | 2280. |
| Total, | 5,500 | | |

**Commerce.**

Justification of a limited expenditure for improvement of river, **84**, 1719; **86**, 1624.

Increase in lumber output due to improvement, **88**, 1794.

In 1893 the construction of a logging road was looked on as a cause for the probable disuse of the stream in the future, **93**, 2644.

**Engineers.**

Chief of Engineers. Reports, **84**, 263; **85**, 291; **86**, 286; **87**, 243; **88**, 229; **89**, 266; **90**, 240; **91**, 309; **92**, 295; **93**, 335.

Engineers in Charge:

Maj. W. E. Merrill, 1884–87. Report, **84**, 1718; (Lt. Col.) **87**, 1832.

Capt. J. C. Post, 1885–87. Reports, **85**, 1892; **86**, 1624.

Maj. D. W. Lockwood, 1888–93. Reports, **88**, 1794; **89**, 1989; **90**, 2279; **91**, 2474; **92**, 2119; **93**, 2644.

Assistant. J. B. Holbrook. Report, **84**, 1719.

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[a] For depth of water obtained by C. P. Goodyear over the outer bar, Brunswick, Ga., up to the date of the act, **95**, 205.

## BUCKHANNON RIVER, W. VA.—Continued.

**Operations.**

**1884–85.** 7 miles of river cleared of obstructions, **85**, 1893.

**1886–87.** Channel opened to Tenmile Creek, **87**, 1832.

**1888–89.** 3,000 c. y. of rock removed from the channel, **89**, 1989.

**1889–90.** 1,106 c. y. rock and 5 log jams removed from the channel, **90**, 2280.

**1891–92.** 3,510 c. y. stone and 160 snags and logs removed from the channel, **92**, 2119.

**Physical characteristics.**

Description of, **84**, 1718, 1720.

A tributary of the Tygart Valley River about 57 miles long, **93**, 2644.

**Plans.**

In 1883 Maj. Merrill reported that a comparatively small expenditure would be justified for the improvement of the river, **84**, 1719.

**Projects.**

The project of 1884 contemplated a rafting channel from Three Forks to Buckhannon, 24½ miles, with a width of 30 f. and a depth of 2 f. during four months of each year, **85**, 291. After an expenditure of $4,500, it was estimated, 1888, that $20,955 was necessary for completion, **88**, 1795.

**Surveys.**

Examination ordered by act of Aug. 2, 1882. Made under the direction of Maj. Merrill (see *Plans*), **84**, 1718.

**BUFFALO.** (See *Great Lakes; Scajacuada Creek, N. Y.*)

**BUFFALO BAYOU.** (See *Galveston Ship Channel and Buffalo Bayou, Tex.*)

**BUFFALO FORK.** (See *White River, Ark. and Mo.*)

## BUFFALO HARBOR, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1826, | $15,000.00, | **66**, iii, 30. |
| 1828, | 34,206.00, | **66**, iii, 30. |
| 1830, | 15,488.00, | **66**, iii, 30. |
| 1831, | 12,900.00, | **66**, iii, 30. |
| 1832, | 10,300.00, | **66**, iii, 30. |
| 1833, | 31,700.00, | **66**, iii, 30. |
| 1834, | 20,000.00, | **66**, iii, 30. |
| 1838, | 68,500.00, | **66**, iii, 30. |
| 1844, | 40,000.00, | **66**, iii, 30. |
| 1852, | 14,000.00, | **66**, iii, 30. |
| 1853, | 349.05, | **66**, iii, 30. |
| 1855, | 452.32 | (relief of J. R. Bowes, act Mar. 2, 1855). |
| 1864, | 15,000.00, | June 28. |
| 1864,[a] | 37,500.00, | act July 2. |
| 1866, | 131,000.00, | **66**, iii, 30. |
| 1867, | 100,000.00, | **68**, 198. |
| 1869,[b] | 89,100.00, | **69**, 22 (allotment). |
| 1870, | 80,000.00, | **70**, 51, 184; **71**, 49. |
| 1871, | 100,000.00, | **71**, 49. |
| 1872, | 75,000.00, | **72**, 45. |
| 1873, | 75,000.00, | **73**, 46. |
| 1874, | 95,000.00, | **74**, 53, 228; **75**, 320. |
| 1875, | 100,000.00, | **75**, 57, 322; **76**, ii, 568. |
| 1876, | 85,000.00, | **76**, 109, ii, 567; **77**, 117. |
| 1878, | 80,000.00, | **78**, 131, 1270. |
| 1879, | 100,000.00, | **79**, 175, 1719. |
| 1880, | 90,000.00, | **80**, 2194. |
| 1881, | 90,000.00, | **81**, 2423. |
| 1882, | 125,000.00, | **82**, 2436. |
| 1884, | 100,000.00, | **84**, 2130. |
| 1886, | 112,500.00, | **86**, 1883. |
| 1888, | 225,000.00, | **88**, 2054. |
| 1890, | 300,000.00, | **90**, 2836. |
| 1892, | 300,000.00, | **92**, 2531. |
| 1894, | 70,000.00, | **95**, 3149. |
| 1897, | 481,250.00, | **97**, 3111. |
| 1898, | 489,746.00, | **98**, 2784. |
| 1899, | 560,498.00, | **99**, 3110. |
| Total, | 4,369,489.37 | |

**Commerce.**

Commerce of Buffalo, **89**, 2383.

Amount of grain (flour included) delivered in New York City by various routes during the year ending December 31, 1890, **91**, 2888.

Buffalo considered one of the great ports of the United States, **95**, 3154.

The congestion of the harbor at times very great, **96**, 3113, **97**, 3110, **98**, 2781.

The Erie Canal considered an important factor in the commerce of the port, **98**, 2780.

Enormous, **99**, 538.

**Contracts.** [c]

**1869.** Baileys & Denny, materials and labor, **69**, 147, 150; **70**, 184; **71**, 217; **74**, 228; **75**, 321.

**1870–71.** D. E. Bailey, materials and labor, **71**, 217; **74**, 228: **75**, 321.

**1874.** Spaulding & Bennet, materials, labor, and dredging, **74**, 228; **75**, 321.

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[a] Erroneously called $52,500, **66**, iii, 30.

[b] Erroneously called $90,000, **69**, 39, 147.

[c] Authority to make contracts and instructions in regard to, **68**, 219.

## BUFFALO HARBOR, N. Y.—Continued.

**1875.** J. F. Blair, materials and labor. W. H. McCurdy, iron. **75**, 321.

**1876.** George T. Talbot, dredging, 26 cents per c. y., **76**, ii, 569.

**1877.** W. H. McCurdy, iron. Ambrose Clark, materials and labor. **78**, 1269.

**1878.** Pratt & Co., iron. F. B. Colton, materials, labor, and dredging. **79**, 1725.

**1880.** Messrs. Pratt & Co., iron for crib construction, D. E. Bailey, crib construction, **80**, 2193, 2204. Gibson & Granger failed to enter into contract, **80**, 2193.

**1881.** Frank Wilson, ironwork, D. E. Bailey and E. J. Kingston, crib construction, **81**, 2421, 2425.

**1882.** A. J. Packard, ironwork, **83**, 1932, 1934.

**1884.** C. E. Williams, crib construction, **84**, 2127. D. E. Bailey, repairs to breakwater, **84**, 2128. I. Farnsworth, iron, D. E. Bailey, repairs to piers, **85**, 2264.

**1885.** D. E. Bailey, breakwater repairs, **85**, 1882.

**1888.** Williams & McConnell, broken stone, $1.84 per c. y.; H. Fleming, Portland cement, $2.09 per barrel; F. O. Norton, natural cement, $1.20 per barrel, **88**, 2034.

**1889.** Union Akron Cement Co., Portland cement, $2.45 per barrel; Fox & Holloway, sand, 80 cents per c. y.; D. McNaughton, iron moorings, $1,852; J. M. McCarthy, recovering concrete blocks washed off the breakwater, $2 per block; J. Longprey & Co., furnishing and driving piles, $8 per pile, **89**, 2386.

**1890.** W. E. Carroll, pebbles, $1.40 per c. y., **90**, 2837. J. H. Ross, Portland cement, $2.45 per barrel; Ira Farnsworth, broken stone, $2 per c. y.; Fox & Holloway, sand, 70 cents per c. y., **90**, 2837.

**1891.** J. Donnelly, breakwater extension, $66,271.16, **91**, 2884. Emil Thiele, Portland cement, $2.58 per barrel, **91**, 2885. D. McNaughton, iron moorings, $65 per mooring, **91**, 2886. J. B. Donnelly, rubblestone, $1.16 per c. y., **91**, 2886. P. G. Straub, broken stone, $1.47 per c. y., **91**, 2886. Fox & Holloway, sand, 90 cents per c. y., **91**, 2886. J. MacGregor, pebbles, $1.75 per c. y., **91**, 2886.

**1892.** J. J. Churchyard, breakwater construction, $107,067.94, **93**, 3110.

**1893.** Daniel Bros., breakwater construction, $92,879.83, **93**, 3110.

**1894.** Wm. S. Bartlemes and W. C. Hiam, test borings, 74 cents per l. f. ($5,000), **95**, 3149.

**1895.** C. A. Dennis, breakwater repairs, actual cost, $2,340.97, **96**, 3113.

**1896.** C. A. Dennis, breakwater repairs, actual cost, $2,933.26, **97**, 3108.

**1897.** Hughes Bros. & Bangs, breakwater construction and sand-catch pier extension, $1,765,450.63, **97**, 3113. Supplementary contracts made for increased quantities of material brought from Canada, **98**, 2780. Extra work on crib, **99**, 3111.

**1899.** Buffalo Dredging Co., construction of concrete superstructure on breakwater (removal of old work; timber, stone, concrete, dredging, ironwork), $70,169.25, **99**, 3111.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 2, 4, 49, 50, ii, 38, 39, iii, 15, 30; **67**, 31, 32; **68**, 43, 44, 219; **69**, 39; **70**, 51; **71**, 49; **72**, 45; **73**, 46; **74**, 52, 53; **75**, 57; **76**, 109, ii, 573; **77**, 116; **78**, 131; **79**, 174; **80**, 229; **81**, 315; **82**, 309; **83**, 317; **84**, 321; **85**, 345; **86**, 340; **87**, 305; **88**, 279; **89**, 330; **90**, 299; **91**, 375; **92**, 354; **93**, 406; **94**, 380; **95**, 414; **96**, 371; **97**, 466; **98**, 458; **99**, 538; **1900**, 606.

BOARDS OF ENGINEERS.

1845. For the consideration of plans for improvement of harbor, **68**, 228. (Gen. Swift, Col. Kearney, and Maj. Turnbull.)

1868. To consider plans submitted by Col. Cram. Recommend the repair of the light-house pier and its extension 300 f., the repair of the north pier, the removal of a portion of the south end of the Erie breakwater, and to dredge the harbor entrance to allow a draft of 15 f. The construction of the breakwater of cribwork should conform to principles already laid down by the Board of 1854 for similar localities as to dimensions of cross section and length. **68**, 220, 224. Col. Cram dissents; see letter and memoir. **68**, 225–231. Reconvened to consider letter and memoir of Col. Cram; reconsider the whole subject, and submit plans and estimate for section of breakwater; estimated cost of 100 f., $19,828.40. Met at Detroit Mar. 27, 1868, and after a general discussion and balloting submitted report. **68**, 232–235. Col. Cram again dissents; see letter and memoir. **68**, 236. (Cols. Cram and Macomb, Lt. Cols. Raynolds, Newton, and Blunt, Maj. Wheeler, and Capt. Harwood.)

Apr., 1873. To consider project of Maj. Harwood to prevent displacement of cribs in breakwater. Concur in his project, except in regard to the dimensions of the stone foundations; report that the stone foundations need only be raised about 4 f. above the bottom of the lake, and should be extended 25 f. exterior to the work and 15 f. on the interior. Report, **73**, 353, 354. (Col.

Macomb and Majs. Houston, Wilson, and Harwood.)

Nov., 1873. To consider the question of accretions of sand and construction of breakwater. Report that a survey is necessary to furnish the requisite data. **74**, 229–232.

Mar., 1874. Approve plan of Maj. Harwood for arresting progress of sand along the beach, viz, by pier of pile and crib work, and for building submerged end of breakwater to full height; report borings necessary to furnish data for final report; submit preliminary report, **74**, 229–232. (Col. Woodruff, Majs. Comstock, Wilson, and Harwood.)

Aug., 1874. Board locate position of catch-sand piers. Object to proposed private piers or transfer of U. S. property near light-house to private parties. Recommend preparing an artificial foundation for a portion of the breakwater by dredging a trench 50 f. wide by 2,500 f. long and filling it with gravel and stone. The breakwater should be prolonged southerly on its present line to a total length of 7,600 f. At the south end of the breakwater a fair-weather exit should be left between the breakwater and the catch-sand pier. The width of the cribs should, in all cases, be equal to their height. **76**, ii, 569. (Col. Woodruff, Lt. Col. Blunt, and Majs. Comstock, Wilson, and Harwood.)

Sept., 1874. Board consider the question of changing location of catch-sand pier; recommend change in location of shore end of pier: Starting from a point on the beach about opposite the south end of Blackwell Canal, extending to 16 f. water in a line at right angles to the shore, and that the oblique branch of the breakwater be changed to correspond to this new position. Report, **76**, ii, 573. (Col. Woodruff, Lt. Col. Blunt, and Maj. Wilson.)

Convened at New York, 1886–87, to consider the reconstruction of the superstructure of the breakwater. Report, **87**, 2362, 2363. (Cols. Casey and Abbot, Lt. Cols. Comstock and Houston.)

Convened at Buffalo, N. Y., Dec. 21, 1888, by S. O. No. 69, to report upon the construction of a plant for building the superstructure of the Buffalo breakwater. First report, **89**, 2388. (Lt. Col. King, Maj. Overman, and Capt. McC. Derby.)

Convened at Buffalo, N. Y., Mar. 6, 1889, to examine and report upon plant for new breakwater superstructure. Second report, **89**, 2391. (Lt. Col. King, Maj. Overman, and Capt. Mahan.)

Convened at Buffalo on May 27, 1895, by S. O. No. 13, 1895, to consider and report upon the plan and estimate submitted by Maj. Ruffner for extending the pier and breakwater at Buffalo, N. Y. Report, **95**, 3153. (Gen. H. L. Abbot, Maj. H. M. Adams, Capt. D. C. Kingman.)

ENGINEERS IN CHARGE:

Capt. Williams, 1839, **67**, 227; **68**, 221, 222.

Capt. I. C. Woodruff, in 1856, **67**, 227.

Col. William Turnbull. (See S. Doc. 1, 34th Cong., 1st sess.)

Col. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess.

Capt. John A. Tardy. Reports, **66**, 49, 50, ii, 38, 39, iv, 161–164; **67**, 32, 135–137, 227–229; **68**, 222.

Col. T. J. Cram, assigned to charge 1867. Reports, **67**, 135–137, 148, 224–233; **68**, 150, 205–219, 225–231, 236–244.

Capt. Franklin Harwood, 1868. Reports, **68**, 193–195, 197, 198; **69**, 145–150, 163–170; **70**, 183; **71**, 217; **72**, 244; **73**, 350; **74**, 226.

Lt. Col. Charles E. Blunt, 1874, **74**, 215. Reports, **75**, 319; **76**, ii, 568; **77**, 972.

Maj. W. McFarland, 1878–83. Reports, **78**, 1269; **79**, 1717; **80**, 2192; **81**, 2420; **82**, 2431.

Lt. Col. H. M. Robert, 1883. Report, **83**, 1931.

Capt. E. Maguire, 1883–86. Reports, **84**, 2126; **85**, 2255; **86**, 1881.

Capt. C. F. Palfrey, 1886, **87**, 2351.

Capt. F. A. Mahan, 1886–90. Reports, **87**, 2351; **88**, 2028; **89**, 2361.

Maj. A. Stickney, 1890–92. Reports, **90**, 2808; **91**, 2882.

Maj. E. H. Ruffner, 1892–95. Reports, **92**, 2529; **93**, 3107; **94**, 2438; **95**, 3146.

Maj. T. W. Symons, 1896–. Reports, **96**, 3110; **97**, 3107; **98**, 2756; **99**, 3101; **1900**, 4113.

ASSISTANTS:

J. S. Lawrence, **66**, iv, 164.

Capt. Franklin Harwood, **67**, 31, 137, 229; **68**, 150, 206.

W. Griswold, **68**, 150.

G. E. Fell, **74**, 233; **75**, 320.

G. U. Mayo. Report, **79**, 1719.

**Estimates.** (See *Plans* and *Projects*.)

By Col. Turnbull, 1856, repairs of tow-path of south pier and rebuilding sea wall, $20,209.85, S. Doc. 42, 35th Cong., 1st sess.

By Col. Graham, 1857, repairs, dredging, etc., $27,679.35, S. Doc. 42, 35th Cong., 1st sess.

By Capt. Tardy, 1865, repairing light-house pier, repairs and completion of sea wall, $131,000, **66**, 4, 49, 50. 1866, extension of light-house pier and a new breakwater with stone superstructure, $1,697,194.78, **66**, iv, 163; **67**, 228.

By Col. Cram, 1867–68, repair and protection of harbor piers, extension of south harbor pier, removal of a portion of the

## BUFFALO HARBOR, N. Y.—Continued.

breakwater, construction of a breakwater 4,000 f. in length, and a navigable ship channel between the lake and Buffalo Creek, $6,484,415.12, **68**, 205, 207, 243.

By Board of Engineers, 1868, a section of breakwater 100 f. in length, $19,828.40, **68**, 235.

By Capt. Harwood, 1869, completion of harbor work and breakwater, construction of south channel and Buffalo sea wall, $926,803.17, **69**, 149.

By Board of Engineers, 1874, catch-sand pier and repairs to breakwater, $83,000, **74**, 232.

By Lt. Col. Blunt, 1875, project of Board of Engineers for extension of breakwater, $1,987,700, **75**, 321.

By Maj. McFarland, 1879, complete existing project, $1,635,000, **79**, 1719.

**Legal proceedings.**

In 1893–94 the officer in charge knew of nothing having been done to regain possession of the north pier from the Delaware, Lackawanna & Western R. R., which had taken unauthorized possession of it, **94**, 2439; **95**, 3147. Detailed description of the case, and of efforts made to obtain the withdrawal of the company from occupancy of the pier, **98**, 2774.

**Legislation.**

In 1897–98 the New York legislature authorized the city of Buffalo to use for highway purposes the sea-wall strip on portions of which the U. S. had built a sea wall in 1830–36, **98**, 2781.

**Operations.** (See also *Private work.*)

**1857.** S. Doc. 42, 35th Cong., 1st sess.

**1864–65.** Repairs in progress on harbor and sea wall, **66**, 4. Details of, **66**, 49, 50, 51.

**1865–66.** On light-house pier several cribs placed in position; 16,710 l. f. of piling driven, and 594 cords of stone for riprap; 1,303 f. of sea wall built, 357 f. of it coped, **66**, 38, 39.

**1866–67.** Work on sea wall continued, **66**, iv, 164; **67**, 136.

**1867–68.** Repairs of pier head and towpath; extension of pier and building about 900 f. of breakwater under contract, **68**, 44.

**1868–69.** The interior works of repair nearly completed; south pier extended nearly 318 f.; 150 f. of breakwater built to low-water level, **69**, 39, 145, 146.

**1869–70.** Repairs of interior harbor works and dredging channel to inner harbor completed; total length of breakwater, 950 f. Superstructure over 400 f. of same, **70**, 51, 183.

**1870–71.** Breakwater extended 783 f.; total length, 1,183 f., **71**, 49, 217.

**1871–72.** Repairs to north pier head and other completed work; 425 f. added to breakwater, partly covered with superstructure, **72**, 45, 244.

**1872–73.** Extension of breakwater. Rectification of injury to 6 cribs. **73**, 350.

**1873–74.** Breakwater repaired and extended 100 f.; dredging done under special appropriation, and work of repair continued to amount of over $23,000 after appropriation was exhausted, **74**, 52, 226–228.

**1874–75.** 180 f. of south end of breakwater rebuilt, 1,500 f. of its lake face protected by oak and iron sheathing, 650 f. of pile pier built, 3,956 c. y. dredged, and foundation trench for cribs in breakwater commenced, **75**, 57, 320.

**1875–76.** Breakwater extended 250 f., with superstructure over 200 f. of same; pile pier extended 220 f., and about 10,000 c. y. dredged from shoal outside of south pier, **76**, 109, ii, 568.

**1876–77.** Breakwater extended 150 f.; total length, 2,924 ft.; channel piers repaired and pile pier refilled, **77**, 116, 972.

**1877–78.** South end of breakwater extended 150 f., **78**, 131, 1270.

**1878–79.** Breakwater extended, making total length 3,076 f., **79**, 1718.

**1879–80.** Breakwater extended by contract 350 l. f.; total present length, 3,426 l. f., **80**, 2193.

**1880–81.** Breakwater extended 694 l. f., making total length of 4,120 l. f., **81**, 315, 2420.

**1881–82.** Breakwater extended 317 l. f., making total present length of 4,437 l. f., **82**, 2431.

**1882–83.** Breakwater extended 454 l. f., making total present length 4,891 l. f. Repairs breakwater and light-house pier, **83**, 1932, 1933.

**1883–84.** Breakwater extension in progress, with repairs to breakwater, **84**, 2127, 2129. Removal of wreck, **84**, 2130.

**1884–85.** Breakwater extended $805\frac{9}{10}$ f., making a total present length of $5,696\frac{9}{10}$ l. f., **85**, 2262. Repairs to breakwater and south pier, **85**, 2265.

**1885–86.** Breakwater extended $659\frac{9}{10}$ f., making a total extension of $6,349\frac{8}{10}$ f., **86**, 1881. Repairs to breakwater, **86**, 1882. Cost of breakwater extension, **86**, 1883.

**1886–87.** Repairs to structures, **87**, 2354.

**1887–88.** Repairs to south pier by hired labor; 750 l. f. of breakwater parapet rebuilt with concrete and masonry superstructure; repairs to breakwater and boathouse, **88**, 2034, 2046.

**1888–89.** South pier repaired by hired labor; breakwater reconstruction

**BUFFALO HARBOR, N. Y.**—Continued.

continued, and manufacture of concrete blocks begun by hired labor; minor repairs to the breakwater, **89**, 2363, 2372.

**1889–90.** Work continued on reconstruction of breakwater superstructure, **90**, 2832.

**1890–91.** 950 concrete blocks manufactured, entire breakwater superstructure removed, and 800 concrete blocks placed in position in reconstruction of the same, **91**, 2883.

**1891–92.** 362 concrete blocks washed from the breakwater recovered and replaced; reconstruction of breakwater continued, **92**, 2530.

**1892–93.** Breakwater construction in progress, **93**, 3108.

**1893–94.** South pier repaired, 800 f. of extension of breakwater in progress of construction at beginning of year completed, **94**, 2439.

**1894–95.** Minor repairs made to the breakwater, **95**, 3148, and harbor lines established, **95**, 3149.

**1895–96.** Older portions of breakwater repaired, **96**, 3112, 3113; 5,385 c. y. rock, etc., dumped along the front of the breakwater, **96**, 3113.

**1896–97.** Older portions of the superstructure of the breakwater repaired, **97**, 3108; 100,865 c. y. clean rock dredgings and waste rock placed along the front of the breakwater, **97**, 3108, 3109. Supervision maintained over the dumping of dredgings of other than Government work, and care of property, and other miscellaneous work performed, **97**, 3109. 13,861 tons of stone placed in breakwater, and extension of sand-catch pier in progress, **97**, 3110.

**1897–98.** 100,000 c. y. rock and other filling material dumped along the front of the breakwater, **98**, 2758. Supervision maintained over dumping by other than Government contractors, **98**, 2758. In connection with previous year, sand-catch pier was extended 278 f., **98**, 2759. 145,304 c. y. stone and 92,279 c. y. gravel placed in breakwater, and timber-crib breakwater jutting out from Stony Point under construction, **98**, 2763.

**1898–99.** South pier and breakwater repaired; preparations made for construction of concrete superstructure on old breakwater; printing of charts of Buffalo Harbor and Niagara River; construction of rubble mound breakwater in progress, about 80,000 tons stone being placed; entire Stony Point section of timber-crib breakwater completed (see also *Private work*), **99**, 3102–3108.

**1899–1900.** Over 100,000 tons stone placed in breakwater extension to Stony Point; work in progress on South Harbor section; construction of concrete superstructure on old breakwater in progress. (*Photographs.*) **1900**, 4114.

**Physical characteristics.**

Description of, **66**, iv, 162; **67**, 135, 225, 226; **69**, 165–168; **70**, 194; **72**, 245; **73**, 351; **76**, ii, 568, 569, 571; **94**, 2240; **95**, 3150, 3153, 3158.

Foundation so unstable as to cause doubling of the estimated cost and to require dredging 19 f. below the bed of the lake to obtain a good foundation for the cribs, **74**, 236; **79**, 1718.

Level of lake during southwest gale of Oct. 14, 1886, **87**, 2352.

Wind observations, **87**, 2351.

In 1893–94 the shore arm of the breakwater showed evidence by sinking that it was located on the edge of a preglacial river, **94**, 2440.

Storms damaging and delaying works, **1900**, 4123.

**Plans.** (See also *Estimate* and *Projects.*)

Early history of plans, **67**, 224–229; **68**, 222.

By Capt. Williams, 1839, extension of pier 2,040 f. to 23 f. of water and a detached breakwater 3,690 f. in length, **66**, iii, 15, iv, 161, 162.

By Capt. Tardy, 1866, urging the adoption of Capt. Williams's plan, **66**, iv, 161, 162.

Discussion of above plans by Col. Cram, viz: Extending the south pier from 300 f. to 600 f., removing 200 f. or 400 f. of south end of Erie breakwater, and a new breakwater 4,000 f. in length, and modifications proposed, **67**, 31, 135–137, 224–229. For a cut or canal 200 f. wide, with pier or piers extending into the lake to 15 f. water, lake to Buffalo Creek, **67**, 229; **68**, 205, 206, 214–216.

**Private (State, corporate) work.**

State of New York, 1819, loaned $12,000 to a committee of citizens on security, to build certain piers; cost $14,000. The south pier, ¼ mile long, ended in 13 f. water; begun in 1820, finished, 1821, under superintendence of S. Wilkinson, **67**, 225.

Erie breakwater, built by the State of New York at great expense, **67**, 226.

Dredging by city of Buffalo, **67**, 225.

Claims of railroad company to U. S. pier, **80**, 2195.

Agreement made with U. S., **80**, 2201.

Question reopened 1884, **85**, 2255.

Improper use of breakwater by parties mooring rafts thereto, **81**, 2421, 2422.

Description of, **95**, 3153.

A large part of the lake frontage owned by the Lehigh Valley and Buffalo Creek railroads who have constructed wharves and warehouses thereon, **95**, 3150.

In 1895 the Secretary of War authorized private persons to dump clean rock dredgings along the lake face of the breakwater, **96**, 3113.

Dredging done in Buffalo River and

## BUFFALO HARBOR, N. Y.—Continued.

Erie Canal by city and State authorities and private persons, **97**, 3109, **98**, 2758, **99**, 3105.

South pier repaired by owners of a vessel which had injured it, **98**, 2757.

**Projects.** (See *Estimates; Plans; Private work.*)

Prior to 1866 appropriations were expended in building and repairing two piers at the mouth of Buffalo Creek, dredging and constructing a masonry sea wall to protect the beach south of harbor entrance.

By Capt. Williams, 1839, **66**, iii, 15, iv, 161; **67**, 227; **68**, 221, 222.

By Capt. Woodruff, 1856, **67**, 227.

By Col. Turnbull, S. Doc. 1, 34th Cong., 1st sess.

By Maj. Graham, 1857, S. Doc. 42, 35th Cong., 1st sess.

By Capt. Tardy, 1865, **66**, 49, 50, ii, 38, 39, iii, 30, iv, 161.

By Col. Cram, 1866, repairs and protection of the north and south piers and extension of the south pier 300 f., **67**, 32, 68, 137, 193, 194.

By Board of Engineers, 1868, repairing the end of the light-house pier and extending it about 300 f., removing a portion of the south end of the Erie Canal basin breakwater, dredging at the harbor entrance to a depth of 15 f., and constructing a breakwater south from the harbor entrance 4,000 f. in length (estimate section of 100 f., $19,828.40, **68**, 235), of cribs 50 f. long by 34 f. base and 29 f. to 37 f. in height, **68**, 222, 232.

By Board of Engineers, 1873, stone foundations for cribs in the breakwater to prevent displacement, **73**, 353.

By Board of Engineers, 1873, increasing the length of the breakwater to 7,600 f., with cribs 50 by 34 by 32 f., and an artificial foundation for about 2,500 f. of the distance, dredged to hard bottom, 50 f. in width, and filled with gravel and stone. A pile pier 1,000 f. long continued by crib work 3,100 f., commencing at a point on the shore opposite the head of the Blackwell Canal and extending toward the south end of the breakwater, leaving a channel between it and the breakwater 150 f. in width; estimate, $2,000,000, **76**, ii, 570; **77**, 972; **79**, 1718.

Detailed history of, **88**, 2028.

Scheme of improvement, as modified at various times, provides for two piers at the entrance to Buffalo Creek, for a masonry sea wall running southwardly from the south pier; for a breakwater about one-half mile from and parallel with the shoal, and for a shore arm to the breakwater from its southerly end, **87**, 305, 2351, 2366.

In 1866 a masonry and concrete superstructure was adopted for the breakwater, **87**, 2353, 2365.

From 1826 to 1886, inclusive, $1,966,480.41 was appropriated. Estimate for completion of project, $1,117,500, **87**, 2357; **91**, 2882.

By Board of Engineers, 1895, for the abandonment of the shore arm, and for the extension of the breakwater from its southern end at that time to Stoney Point, leaving necessary openings for the convenience of commerce; estimate $2,200,000, **95**, 3157. Addition was made by Congress in 1896, providing for the extension of the catch-basin pier to the established pier-head line under continuous contract, **96**, 3111.

By Maj. Symons, 1896, for modification of plan and location for breakwater, to provide for the construction of a section of breakwater 9,700 f. long, beginning at the southerly end of the old breakwater, leaving a fair-weather entrance between, and thence extending south in a straight line, 5,000 f. of the northerly part to be of rubble-mound type, and the remaining portion to be of timber-crib type, mounted upon an artificial foundation extending down to solid rock. Another section of timber-crib breakwater, 2,800 f. long, to extend out from the shore at Stoney Point in a northwesterly direction, leaving an entrance 600 f. wide between the two structures, also provided for. **98**, 2760.

By Maj. Symons, 1899, for repair of south pier, **1900**, 4114.

**Surveys.**

By William Peacock, 1818, **67**, 224.

Under direction of Capt. Williams, 1839, **67**, 227.

Under direction of Col. Cram, 1867, by Capt. Harwood, assisted by W. Griswold, **68**, 150, 206; **69**, 164.

By direction of Board of Engineers under Maj. Harwood, **74**, 52, 53.

Preliminary examination and survey of Scajacuada Creek, **85**, 2283, 2284.

Surveys for lake survey charts, made in 1893–95, by Maj. Ruffner, **94**, 2442; **95**, 3149.

In 1894–95 investigations were made by Capt. Kingman to ascertain the probable cost of stone suitable for use in the extension of Buffalo breakwater, **95**, 3157.

Plan and estimate for extending the breakwater from the southerly end of the harbor to Stoney Point was asked for by act of Aug. 17, 1894, and the necessary surveys were made and a report submitted in 1895 by Maj. Ruffner, **95**, 3149.

Soundings were made in 1896 through the ice to ascertain the character of the

## BUFFALO HARBOR, N. Y.—Continued.

lake bottom on the line of the proposed breakwater, by Maj. Symons, **96**, 3113.

Miscellaneous soundings, examinations, and surveys were made in 1897–98; by Maj. Symons, **97**, 3109; **98**, 2759.

In 1897–98 soundings were taken by means of a specially constructed sounding scow, by Maj. Symons, **98**, 2758.

MAPS. Of northern and northwestern lakes, showing location of the harbor, **66**; of harbor and vicinity, **66**.

Map of the harbor, June 30, 1879, **79**, 1720.

**80**, 2204; **81**, 2424; **84**, 2130; **87**, 2356; **88**, 2054; **89**, 2370; **95**, 3160; **98**, 2784. (*Photographs*, see *Operations*, 1900).

## BUFFALO (BLACK ROCK) HARBOR AND BUFFALO ENTRANCE TO ERIE BASIN, N. Y.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1899, | $50,000.00, | **99**, 3114. |
| 1900, | 191,701.25, | **1900**, 4137. |
| Total, | 241,701.25 | |

**Commerce.**

Important, **97**, 3246, 3247.

**Contracts.**

**1899.** J. B. Donnelly, breakwater construction (excavating, stone, timber cribs, concrete, ironwork), $210,175, **1900**, 4138.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **97**, 473; **99**, 540; **1900**, 608, 611.

ENGINEER IN CHARGE:

Maj. T. W. Symons, 1897–. Report, **97**, 3245; **99**, 3114; **1900**, 4135.

**Operations.**

**1899–1900.** Substructure of breakwater in process of construction, **1900**, 4136.

**Physical characteristics.**

Description of; entrance to the basin and harbor is an opening 2,300 feet wide between two breakwater structures near the shore along the lake front of Buffalo, N. Y., built by the State of New York, **97**, 3246.

**Projects.**

By Maj. Symons, 1897, breakwater 2,300 feet long, covering and protecting the entrance to the Erie Basin and Black Rock Harbor, and the lake front of Buffalo Harbor, between the New York State structures; estimate, $248,000, **97**, 3246; **99**, 3114.

**Surveys.**

Survey of the Buffalo entrance to the Erie Basin and Black Rock Harbor, N. Y., ordered by act of June 3, 1896, made by Maj. Symons, 1897 (see *Projects*), **97**, 3245.

Examination of the Lake Erie entrance ordered by act of June 6, 1900, **1900**, 611.

## BUFFALO RIVER, MISS.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 225.

ENGINEER IN CHARGE: Capt. T. Turtle. Report, **85**, 1430.

**Survey.**

Examination ordered by act of July 5, 1884; made under direction of Capt. Turtle (report unfavorable), **85**, 1430.

## BULKHEAD ROCK, R. I. (See *Providence River Harbor, etc.*)

## BURLINGTON BAY, MINN. (See *Agate Bay, Minn.*)

## BURLINGTON CANAL. (See *Wells River to Burlington Canal.*)

## BURLINGTON HARBOR, IOWA. (See *Mississippi River, from St. Paul to Des Moines Rapids.*)

## BURLINGTON HARBOR, VT.[b]

**Appropriations.**

| | | |
|---|---|---|
| 1836, | $10,000.00, | **66**, iii, 28. |
| 1837, | 10,000.00, | **66**, iii, 28. |
| 1838, | 50,000.00, | **66**, iii, 28. |
| 1844, | 10,000.00, | **66**, iii, 28. |
| 1852, | 10,000.00, | **66**, iii, 28. |
| 1864, | 308.00. | (H. Doc. 373, 1882.) |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1864, | 13,500.00, | **66**, iii, 28. |
| 1866, | 27,672.20, | **66**, iii, 28. |
| 1867, | 80,000.00, | **67**, 234. |
| 1870, | 25,000.00, | **70**, 56, 223. |
| 1871, | 30,000.00, | **71**, 53. |
| 1872, | 30,000.00, | **72**, 49, 272. |

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[a] Survey.—Report, Oct. 1, 1836; estimate, $321,430.20. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Survey.—Report, Feb. 7, 1834; estimate, $28,727.18. (H. Doc. No. 482, 55th Cong., 2d sess.)

## BURLINGTON HARBOR, VT.—Continued.

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1873, | 25,000.00, | **73**, 49. |
| 1874, | 25,000.00, | **74**, 56, 275. |
| 1875, | 25,000.00, | **75**, 61, 353. |
| 1876, | 20,000.00, | **76**, 57, 258; **77**, 52, 253. |
| 1878, | 20,000.00, | **78**, 57, 422. |
| 1879, | 15,000.00, | **79**, 65, 396. |
| 1880, | 10,000.00, | **80**, 558. |
| 1881, | 10,000.00, | **81**, 724. |
| 1882, | 12,000.00, | **82**, 709. |
| 1884, | 50,000.00, | **84**, 2157. |
| 1886, | 18,750.00, | **86**, 1904. |
| 1888; | 35,000.00, | **88**, 2099. |
| 1890, | 20,000.00, | **90**, 2880. |
| 1894, | 10,000.00, | **95**, 3237. |
| 1896, | 10,000.00, | **96**, 3168. |
| 1899, | 15,000.00, | **99**, 1290. |

Total, 617,230.20

**Contracts.**[a]

**1867.** C. J. DeGraw, timber, **67**, 245. R. N. Gere, iron, **67**, 245. Luther Whitney, stone, **67**, 245; Jennings & Hart, labor, **67**, 245; Hart & Jennings, timber and plank, **68**, 295, 299.

**1873.** Luther Whitney, crib work, **73**, 395. [b]Charles DeGraw, crib work, **73**, 395. Luther Whitney, crib work, **74**, 274; **75**, 353.

**1874.** Luther Whitney, one crib, **75**, 354; **76**, 258.

**1875.** James D. Hancock, cribs, **75**, 354; **76**, 258; **77**, 253.

**1878.** Luther Whitney, breakwater extension, **79**, 396.

**1882.** Dillabeck & Murphy, rubblestone, 70 cents per c. y., **82**, 709.

**1884.** L. Whitney, breakwater extension, **85**, 2307.

**1894.** L. Whitney, breakwater repairs, $21,948.30, **95**, 3238.

**1897.** E. S. Fleury, breakwater superstructure construction, $31.50 per l. f.; furnishing and setting quarry-faced stones, $6 per c. y.; filling space between cribs, 50 cents per c. y., **97**, 3298.

**1899.** W. J. Daly, repairing breakwater, $14,870 or $15,500, **1900**, 1483.

**Defense.**

Harbor would afford protection to our armed ships in time of war, S. Doc. 42, 35th Cong., 1st sess.

**Engineers.**

CHIEF OF ENGINEERS. Reports **66**, 2, 3, ii, 41, iii, 17, 28, **67**, 34; **68**, 48; **69**, 42; **70**, 56; **71**, 53; **72**, 49; **73**, 49, 50; **74**, 56; **75**, 61; **76**, 57; **77**, 52; **78**, 57; **79**, 65; **80**, 89; **81**, 113; **82**, 114; **83**, 325; **84**, 328; **85**, 355; **86**, 349; **87**, 315; **88**, 288; **89**, 341; **90**, 308; **91**, 386; **92**, 364; **93**, 417; **94**, 390; **95**, 427; **96**, 382; **97**, 480; **98**, 129; **99**, 148; **1900**, 168.

BOARD OF ENGINEERS:

Convened June 6, 1867, to consider location and construction of breakwater. Recommended the extension of old breakwater about 1,500 f. to the north, and construction of cribs of rectangular cross-section 30 f. at base and 40 f. high, **67**, 34, 234, 251. (Col. Bache and Lt. Cols. Thom and Blunt.)

ENGINEERS IN CHARGE:

Col. Turnbull. S. Doc. 42, 35th Cong., 1st sess.

Maj. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess.

Maj. C. E. Blunt, 1865–67. Reports, **66**, 56, 57; (Lt. Col.), **67**, 234, 245, 246, 251.

Capt. C. B. Reese, 1866. Reports, **66**, iv, 179, 180.

Capt. J. W. Barlow, 1867–69. Reports, **68**, 295; **69**, 184.

Lt. Col. John Newton, 1870–79. Reports, **70**, 223; **71**, 255; **72**, 272; **73**, 394; **74**, 274; **75**, 353; **76**, 258; **78**, 422; **79**, 395.

Capt. James Mercur, in temporary charge, **77**, 253.

Lt. Col. N. Michler, 1880–81. Reports, **80**, 557; **81**, 723.

Maj. G. L. Gillespie, 1881–82. Report, **82**, 708.

Maj. W. McFarland, 1882–83. Report, **83**, 1931.

Lt. Col. H. M. Robert, 1883–85. Reports, **83**, 1959; **84**, 2157.

Maj. M. B. Adams, 1885–92. Reports, **85**, 2307; **86**, 1903; **87**, 2406; **88**, 2098; **89**, 2448; **90**, 2879; **91**, 2933; **92**, 2609.

Capt. S. S. Leach, 1893–96. Reports, **93**, 3196; **94**, 2496; **95**, 3236; **96**, 3167.

Maj. W. S. Stanton, 1897. Report, **97**, 3296.

Maj. A. M. Miller, 1898. Report, **98**, 1043.

Col. J. W. Barlow, 1899–. Reports, **99**, 1289; **1900**, 1482.

ASSISTANTS:

Lt. C. J. Allen, **66**, ii, 41, iv, 178; **67**, 34.

D. White, **74**, 275; **76**, 253.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Col. Graham, extension and repairs, $21,286.31, S. Doc. 42, 35th Cong., 1st sess.; $27,672.20, **66**, 3.

By Capt. Reese, 1,500 f. of new breakwater, $333,442, **66**, iv, 180; **67**, 234; **68**, 49; **69**, 42.

By D. White and Lt. Col. Newton,

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[a] Failing bidders, Wells DeGraw, Antoin Poupor, L. B. Platt, and L. T. Richardson, **68**, 296, 299.

[b] Annulled and awarded to Luther Whitney, **74**, 274; **75**, 353.

**BURLINGTON, HARBOR, VT.**—Continued.

2,000 f. of breakwater, $340,000, **74**, 275; **75**, 353; **76**, 258.
By Lt. Col. Newton, completion of project, $260,000, **79**, 396.

**Operations.**[a]
**1844.** Construction of breakwater, **66**, iii, 17, iv, 179.
**1857.** Breakwater 1,069 f. in length, S. Doc. 42, 35th Cong., 1st sess.
**1868.** Two cribs well under way, **68**, 298.
**1868–69.** Six cribs, 500 f. of breakwater built, **69**, 42.
**1869–70.** Construction of 2 cribs, 160 l. f., **70**, 56, 223.
**1870–71.** Construction of 2 cribs, 171 l. f., **71**, 53, 255.
**1871–72.** Two cribs, 217 l. f., placed in position for south extension; completion of superstructure over extension, **72**, 48, 272.
**1872–73.** Construction of 2 cribs, 180 l. f., **73**, 49, 395.
**1873–74.** Construction of 2 cribs, 220 l. f., and 180 f. of superstructure, **74**, 56, 274.
**1874–75.** Construction of crib, 145 f., and 220 f. of superstructure, **75**, 61, 353.
**1875–76.** Construction of 160 f. north extension and 145 f. of superstructure, **76**, 57, 258.
**1876–77.** Completion of 160 f. of superstructure, repairs, **77**, 52, 253.
**1877–78.** Repairs and extension of breakwater, **78**, 57,422.
**1878–79.** Riprapping and extension of breakwater, **79**, 65, 395.
**1879–80.** Breakwater extended north 111 l. f.; repairs to breakwater, **80**, 557.
**1880–81.** Breakwater extended north 70 l. f.; repairs to breakwater, **81**, 723.
**1881–82.** Breakwater extension in progress, **82**, 709.
**1882–83.** Breakwater extended north 50 l. f., **83**, 1959.
**1883–84.** Breakwater extended north 50 l. f., **84**, 2157.
**1884–85.** Breakwater extended south 200 l. f.; 1,175 l. f. of old breakwater repaired by hired labor, **85**, 2307.
**1885–86.** Repairs to breakwater by hired labor, **86**, 1903.
**1886–87.** Slight repairs to northern end of breakwater, **87**, 2409. Discussion of most economical height of stone foundations for breakwater, **87**, 2407.
**1887–88.** 4,209 c. y. rubblestone placed in breakwater foundation, **88**, 2099.
**1888–89.** 780 c. y. rubblestone placed in breakwater foundation, **89**, 2449.
**1890–91.** Repairs to breakwater, **91**, 2934.
**1891–92.** Repairs to 1,000 l. f. of superstructure, **92**, 2611.
**1895–96.** 683 l. f. breakwater repaired, **96**, 3167.
**1896–97.** Breakwater repairs in progress, **97**, 3297.
**1897–98.** 235 l. f. of stone superstructure completed, **98**, 1044.

**Physical characteristics.**
**66**, iii, 17.

**Plans.** (See *Estimates; Projects.*)
By Capt. C. B. Reese, new breakwater north and west of old work, 1,500 f. long, **67**, 179, 180.

**Projects.**
Between 1836 and 1857, 1,069 l. f. of breakwater had been built. In 1867 a Board of Engineers recommended a further extension northward of 1,500 l. f. In 1871, 831 l. f. of this extension had been made. **67**, 34, 234, 251.
Between 1871 and 1874, 617 l. f. were added in a southward extension, making a total extension of 2,517 l. f., **74**, 274.
In 1874 an additional extension of 2,000 l. f. was adopted, estimate, $340,000, **74**, 275.
In 1884, under an appropriation of $25,000, extensive repairs were undertaken over the part of the breakwater built between 1836 and 1857. In 1886 Maj. Adams proposed a further extension of the breakwater, both to the north and south, with the gradual withdrawal of the work as prolonged into water 32 f. deep. **87**, 315, 2406.
From 1836 to 1886, inclusive, $526,922.20 was appropriated. Completing project. Estimate, 1887, $184,250. **87**, 2409.

**Surveys.**
By Lt. Allen, under direction of Capt. Reese, **66**, iv, 180; **67**, 251; **69**, 185.

MAPS.
Of Northern and Northwestern Lakes, showing location of improvement, **66**.
Of vicinity, showing breakwater and part of city, **66**.
**97**, 3298.

**BURNET, VT.** (See *Connecticut River.*)

**BURNSIDE.** (See *Lake Burnside.*)

**BURTON'S BAY, VA.** (See *Franklin City.*)

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[a] History, **74**, 274.

## BUSH RIVER, MD.

**Engineers.**

Chief of Engineers. Reports, **81**, 150; **82**, 144.

Engineer in Charge. Col. W. P. Craighill. Report, **82**, 949.

**Plans.**

By Col. Craighill, dredged channel to Public Landing 6 f. deep at m. l. w. and 100 f. wide; also a basin at Public Landing 200 by 400 f.; estimate, $30,000. To continue the improvement to mouth of James, cost would be $27,000 additional. **82**, 950.

**Survey.**

Examination ordered by act of Mar. 3, 1881, made under direction of Col. Craighill, **82**, 949.

## BUTTERMILK CHANNEL, NEW YORK HARBOR. (See *Bay Ridge Channel* and *Gowanus Bay, N. Y.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $60,000, | **80**, | 506. |
| 1881, | 60,000, | **81**, | 630. |
| 1882, | 60,000, | **82**, | 655. |
| 1884, | 10,000, | **84**, | 704. |
| 1886, | 56,250, | **86**, | 722. |
| 1888, | 100,000, | **88**, | 612. |
| 1892, | 100,000, | **92**, | 816. |
| 1894, | 50,000, | **95**, | 942. |

Total, 496,250

**Commerce.**

Important, **84**, 602; **86**, 721; **87**, 707.

**Contracts.**

**1880.** H. E. Du Bois, dredging, 35 cents per c. y., **81**, 631.

**1881.** H. E. Du Bois, dredging, 22 cents per c. y., **82**, 655.

**1882.** H. E. Du Bois, dredging, 22 cents per c. y., **83**, 543.

**1884.** H. E. Du Bois, dredging, 33 cents per c. y., **85**, 671.

**1886.** United States Dredging Co., dredging, 23½ cents per c. y.; contract annulled and work prosecuted by H. E. Du Bois's Sons, 25 cents per c. y., **87**, 705.

**1889.** J. A. Simmons, dredging, 18½ cents per c. y., **89**, 782.

**1892.** International Dredging Co., dredging, 32 cents per c. y. ($111,180), **93**, 1052.

**1894.** R. R. Moore, dredging, 25 cents per c. y. ($42,500), **95**, 943.

**Engineers.**

Chief of Engineers. Reports, **80**, 82; **81**, 99; **82**, 100; **83**, 96; **84**, 102; **85**, 92; **86**, 97; **87**, 60; **88**, 61; **89**, 78; **90**, 69; **91**, 88, 93; **92**, 92; **93**, 100; **94**, 90; **95**, 102.

Engineers in Charge:

Col. J. Newton, 1880–84. Reports, **80**, 505; **81**, 629; **82**, 654; **83**, 542.

Capt. J. Mercur, 1884. Report, **84**, 701.

Lt. Col. W. McFarland, 1884–89. Reports, **85**, 670; **86**, 720; **87**, 703; **88**, 610.

Lt. Col. G. L. Gillespie, 1889–95. Reports, **89**, 780; **90**, 724; **91**, 911, 937; **92**, 814; **93**, 1050; **94**, 761; **95**, 940.

**Operations.**

**1880–81.** 80,000 c. y. dredged, **81**, 100.

**1881–82.** 137,545 c. y. dredged, **82**, 654.

**1882–83.** 232,375 c. y. dredged, **83**, 542.

**1883–84.** 207,090 c. y. dredged, **84**, 701.

**1884–85.** 30,097 c. y. dredged, **85**, 671.

**1886–87.** 89,625 c. y. dredged, **87**, 705.

**1889–90.** 206,199 c. y. dredged. **90**, 726.

**1890–91.** 190,000 c. y. dredged, **91**, 913.

**1891–92.** Channel completed through shoal at southern entrance, **92**, 815.

**1892–93.** 32,308 c. y. dredged, **93**, 1051.

**1893–94.** 345,090 c. y. dredged, **94**, 762.

**1894–95.** 52,602 c. y. dredged, **95**, 942.

**Physical characteristics.**

Description of, **88**, 610.

**Plans.**

In 1890 Lt. Col. Gillespie reported Buttermilk and Gowanus Bay channels worthy of a 26-f. channel, **91**, 938.

**Projects.** (See *Plans.*)

By Col. Newton, 1880, removal of the shoal between Long Island and Governors Island to a depth of 26 f. and to a width of 850 f. from the Brooklyn wharves; estimate, $210,000, **80**, 506; **81**, 629; **86**, 721. In 1887, after an aggregate appropriation of $190,000, Lt. Col. McFarland estimated that $95,000 would be required to complete the project, **87**, 705.

**Surveys.**

Maps. **80**, 506; **84**, 702; **85**, 670.

**BUZZARDS BAY AND BARNSTABLE BAY CANAL.**[a] (See *Cape Cod Ship Canal.*)

**BYRAM HARBOR, CONN.** (See *Port Chester Harbor, N. Y.*)

**Commerce.**
An average yearly business of $96,000 done, **95**, 864.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 93.
ENGINEER IN CHARGE. Lt. Col. H. M. Robert, 1894–95. Report, **95**, 863.
ASSISTANT. Lt. W. E. Craighill. Report, **95**, 863.

**Physical characteristics.**
Description of, **95**, 863.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made under direction of Lt. Col. Robert, 1894. Report (favorable), **95**, 863.

**CABIN CREEK, MD.**

**Commerce.**
Unimportant, **80**, 739.

**Engineers.**
ENGINEER IN CHARGE. Maj. W. P. Craighill, 1880. Report, **80**, 738.

**Physical characteristics.**
Description, **80**, 739.

**Surveys.**
Survey ordered by act of March 3, 1879; **79**, 81.
Examination made by Maj. W. P. Craighill, **80**, 739.

**CACAPON RIVER.** (See *Great Cacapon River, W. Va.*)

**CACHE RIVER, ARK.** (See *White River, Black, etc.*)

**Appropriations.**
1888, $7,000, **89**, 1659.
1892, 2,000, **92**, 1687.
1894, [a]2,000, **99**, 2039.
1896, [b]2,000, **99**, 2039.
1899, 1,000, **99**, 2039.
Total, 14,000

**Commerce.**
Unimportant, **71**, 354.
Commerce in past years quite extensive, **81**, 1480.
Great prospective advantages to commerce to result from opening the river, **91**, 2052.
Description of. Consists of rafting and small flatboats handled by the current, **94**, 1554; **95**, 2024.
The commerce for 1900 was 11,215 tons, valued at $29,961, **1900**, 421.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **70**, 31, 66; **71**, 58, 59; **81**, 213; **87**, 210; **88**, 189; **89**, 222; **90**, 200; **91**, 253; **92**, 244; **93**, 276; **94**, 254; **95**, 283, 286; **96**, 246; **99**, 366; **1900**, 421.
ENGINEERS IN CHARGE:
Lt. Col. W. F. Raynolds, 1871. Report, **71**, 354.
Maj. W. H. H. Benyaurd, 1881. Report, **81**, 1477.
Capt. H. S. Taber, 1887–93. Reports, **87**, 1547; **89**, 1659; **90**, 1946; **91**, 2051; **92**, 1687; **93**, 2114.
Capt. C. F. Palfrey, 1894. Report, **94**, 1554.
Lt. Wm. L. Sibert, 1895. Report, **95**, 2024, 2037.
Lt. R. McGregor, 1899–. Reports, **99**, 2039; (Capt.), **1900**, 2602.
ASSISTANTS:
D. Fitzgerald. Report, **71**, 354.
Z. Harrison. Report, **80**, 1478.
P. R. Van Frank, jr. Reports, **95**, 2038; **1900**, 2603.

**Obstructions.**
Little Rock and Memphis R. R. bridge at Old Boyds landing an obstruction to through steamboat navigation, and said to be the cause of steamboats leaving the river, **95**, 2024.

**Operations.**
**1888–89.** Snag boat *Riverside* built; 67 snags, 14 drift piles, and 69 overhanging trees removed, **89**, 1659.
**1889–90.** 341 snags, 158 trees, and 20 drift piles removed, **90**, 1947.
**1892–93.** Nearly 1,600 snags and other obstructions removed, **93**, 2114.
**1893–94.** Over 500 snags, etc., removed, **94**, 1554.

[a] Examination—Report (favorable), Feb. 3, 1825. Survey—Report, Feb. 15, 1825, and Nov. 13, 1829; estimate, $455,815.68 and $704,437.20. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] Allotted from White River.

## CACHE RIVER, ARK.—Continued.

**1899–1900.** About 3,700 snags and other obstructions removed from channel, **1900**, 2603.

**Physical characteristics.**

Description of, **81**, 1479; **95**, 2024.

A severe storm, 1893, blocked the river with fallen timber, **94**, 1554.

Description of, to Riverside, **95**, 2037.

**Plans.**

By D. Fitzgerald, removing overhanging trees and snags; estimate, $4,000, **71**, 354, 355.

By Maj. Benyaurd, 1880, improving the river, mouth to Gray's Ferry, 160 miles, by removing snags, logs, and overhanging trees; estimate, $30,316, **81**, 1478.

**Projects.**

By Capt. Taber, 1887, removing snags, mouth to Riverside; estimate, $7,000, **87**, 1548; increased to $10,000 in 1891, **91**, 2053.

The small plant consolidated with that of White River, **94**, 1554.

**Surveys.**

Ordered by act of July 11, 1870, assigned to Lt. Col. W. F. Raynolds, made under his direction by D. Fitzgerald. Report, **71**, 354.

Examination to Riverside with a view to slack-water navigation, ordered by act of Aug. 17, 1894, made under the direction of Lt. Sibert, 1895, **95**, 2037 (report favorable to snagging).

## CACHE RIVER, ILL., prevention of break from Mississippi River at Beechridge. (See *Mississippi River.*)

## CADDO LAKE, TEX. AND LA. (See *Cypress Bayou.*)

## CAHABA RIVER, ALA.

**Appropriations.**

1882, $20,000, **83**, 998.
1884, 10,000, **84**, 1189.
1886,[a] 7,500, **86**, 202.
1892, 7,500, **92**, 1434.

Total, 45,000

**Commerce.**

Important, **75**, ii, 16.

Benefits to be derived from improvement, **81**, 1233, 1236.

Increase of commerce caused by improvement, **85**, 1309.

**Encroachments.**

Bridges crossing river without draws, **87**, 1287.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 82; **80**, 141; **81**, 189; **83**, 191; **84**, 199; **85**, 204; **86**, 202; **87**, 170; **88**, 157; **89**, 183; **90**, 165; **91**, 210; **92**, 204; **93**, 226; **94**, 209.

ENGINEERS IN CHARGE:

Capt. A. N. Damrell, 1875–85. Reports, **75**, ii, 11; **81**, 1232; **83**, 995; **84**, 1186.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1295; **86**, 1172; **87**, 1287; **88**, 1185.

Capt. P. M. Price, 1889–93. Reports, **89**, 1398; **90**, 1651; **91**, 1754; **92**, 1432; **93**, 1735.

Maj. F. A. Mahan, 1894. Report, **94**, 1298.

ASSISTANTS:

M. J. Mack. Report, **75**, ii, 11.

T. W. Nicoll, **75**, ii, 11.

C. B. Percy. Reports, **81**, 1233; **91**, 1755; **92**, 1433.

Lt. C. L. Potter. Report, **90**, 1653.

**Obstructions.**

Bridges obstructing navigation upon the Cahaba, **75**, ii, 13; **88**, 1186; **90**, 1653.

Description of, **93**, 1737.

Navigation completely blocked by two bridges, **93**, 1737.

**Operations.**

**1882–83.** 5,832 overhanging trees, stumps, logs, and snags removed, **83**, 997.

**1883–84.** 19,750 overhanging trees, stumps, logs, and snags removed, 220 l. f. brush jetties built, **84**, 1187.

**1884–85.** Snag boat constructed, **85**, 1308.

**1885–86.** 1,516 snags, logs, and trees removed, clearing the river for about 19½ miles, **86**, 1174.

**1890–91.** Act of Sept. 19, 1890, having removed the restriction upon the expenditure of available funds, construction of a light-draft log boat was begun, **91**, 1755.

**1891–92.** 1,613 snags and logs removed from the channel; 277 c. y. gravel excavated; 1,550 l. f. willow jetty constructed, **92**, 1433.

**1892–93.** 7,176 obstructions from banks and stream, 23 c. y. rock, and 1 railroad bridge truss were removed, **93**, 1736.

**1893–94.** 7,515 obstructions and a wreck removed, **94**, 1300.

**Physical characteristics.**

Table of shoals and other obstructions, **75**, ii, 14.

Description of, **75**, ii, 12; **81**, 1233.

Character and slope of river bed, **88**, 1186.

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[a] The act of 1886 provides that no part shall be expended until bridges crossing the river are provided with suitable draws, **87**, 1287.

## CAHABA RIVER, ALA.—Continued.

**Plans.** (See *Projects.*)

By M. J. Mack: (1) Safe flat-boat navigation from Centerville down, stage of 3 f. above low water, by operations of a snag boat; estimate, $40,000. (2) Navigation, enabling steamers drawing not over 3 f. to ascend as far as Centerville at all seasons by the operations of a snag boat, by dredging, rock excavation, and construction of dams; estimate, $194,598.75. (3) Lock and dam improvement to reach the Cahaba coal fields. Comparison of various plans. **75**, ii, 13, 14, 15, 16.

By Maj. Damrell, 1883, to obtain for the Lower Cahaba River a navigable channel from its mouth to the town of Centerville, 88 miles, giving a depth of 3 f. at low water and a width in open river of 100 f., and in soft rock and bar cuts 60 f.; by removal of snags, dredging through soft rock and gravel bars, and by contracting and regulating the channel; estimate, $195,000, **83**, 996; **86**, 202; **87**, 1287; **92**, 1432.

In 1894 Maj. Mahan recommended discontinuing improvement on account of the inability to prevent several bridges from obstructing the stream, **94**, 1300.

**Surveys.**

By M. J. Mack, 1874. Report, **75**, ii, 11.

From Centerville to Shades Creek, **81**, 1232.

**CAHOKIA CHUTE, MISS. RIVER.** (See *Mississippi River opposite St. Louis.*)

**CAILLOU BAYOU.** (See *Grand Caillou Bayou; Little Caillou Bayou.*)

**CAIRO, ILL.** (See *Mississippi River; Transportation Routes to the Seaboard.*)

**CALAIS, ME.** (See *St. Croix River.*)

**CALCASIEU LAKE AND RIVER, LA.** (See *Sabine Lake, Pass*, and *Sabine River.*)

## CALCASIEU RIVER AND PASS, LA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1872, | [a]$15,000, | **73**, | 65. |
| 1881, | [b]3,000, | **81**, | 1301. |
| 1881, | [a]12,000, | **81**, | 1305. |
| 1882, | [b]7,000, | **82**, | 1386. |
| 1882, | [a]3,000, | **82**, | 1388. |
| 1884, | [b]6,500, | **84**, | 1282. |
| 1888, | 10,000, | **88**, | 1257. |
| 1890, | 75,000, | **90**, | 1751. |
| 1892, | 100,000, | **92**, | 1506. |
| 1894, | 90,000, | **95**, | 1773. |
| 1896, | 80,000, | **96**, | 1511. |
| 1899, | 35,000, | **99**, | 1854. |
| Total, | 436,500 | | |

**Commerce.**

Description of, **71**, 68, 558; **74**, 721.

Extent to which further improvement of river and pass would benefit commerce, **89**, 1528.

**Contracts.**

**1881.** G. C. Fobes & Co., dredging, $10,444, **82**, 1387.

**1894.** C. Clarke & Co., capping jetty with stone, $4.59 per long ton ($55,080), **95**, 1773.

**1896.** J. Winches, jetty extension; brush mattresses, $1.20 per s. y., riprap stone $2.95 per ton, and granite capping $4.60 per ton ($22,510), **96**, 1511. C. Clarke & Co., west jetty extension; brush mattresses, 91 cents per s. y. riprap stone $2.80 per ton, and granite capping $4.50 per ton ($62,830), **97**, 1770.

**1898.** C. Clarke & Co., operating Government dredge, $29 per day, **98**, 1481.

**1899.** Christie & Lowe, extending west jetty; mattress 80 cents per s. y., riprap stone $2.20 per ton ($33,900), **1900**, 2267.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 68; **72**, 61; **73**, 65; **74**, 73; **80**, 146; **81**, 196, 1302; **82**, 192; **83**, 211, 213; **84**, 215; **85**, 221, 222; **86**, 220; **87**, 185; **88**, 171; **89**, 199, 202; **90**, 180; **91**, 226; **92**, 220; **93**, 247; **94**, 228; **95**, 255; **96**, 222; **97**, 286; **98**, 276; **99**, 330; **1900**, 375.

ENGINEERS IN CHARGE:

Capt. C. W. Howell, 1871–82; **71**, 67; **72**, 60; **73**, 63; **74**, 72. Reports, **71**, 557; **73**, 634; **74**, 721; **81**, 1300, 1301, 1304.

Maj. A. Stickney, 1881–84. Reports, **82**, 1385, 1386; **83**, 1127, 1129; **84**, 1281, 1282.

Capt. T. Turtle, 1884–85. **85**, 1409, 1414.

Maj. W. H. Heuer, 1885–87. Reports, **85**, 1409, 1414; **86**, 1276, 1277; **87**, 1378, 1402.

[a] Calcasieu Pass.

[b] Calcasieu River.

## CALCASIEU RIVER AND PASS, LA.—Continued.

Capt. W. L. Fisk, 1888–91. Reports, **88,** 1256; **89,** 1492, 1527; **90,** 1750.

Maj. J. B. Quinn, 1890–99. Reports, **91,** 1829; **92,** 1504; **93,** 1830; **94,** 1373; **95,** 1770; **96,** 1509; **97,** 1768; **98,** 1480; **99,** 1853.

Maj. H. M. Adams, 1900–. Report, **1900,** 2266.

Assistants:

A. C. Bell. Report, **81,** 1302.
N. S. Davis. Report, **83,** 1127.
Lt. O. T. Crosby. Report, **87,** 1379.
T. L. Raymond. Report, **87,** 1403.

**Operations.**

**1870–71.** Survey, **71,** 557.

**1872–73.** Channel 2,962 f. long and 60 f. wide, dredged, **73,** 65, 634.

**1873–74.** Channel completed to a width of 60 f. and a depth of 6.5 f. from deep water in Calcasieu Pass to Calcasieu Lake, **74,** 73, 721.

**1881–82.** Dredging, **82,** 1387.

**1886–87.** Partial construction of pile revetment for channel over bar. Excavating of a channel 100 f. wide and 6 f. deep begun in 1887 through bar at mouth of river; 13,408 l. f. revetment wall built. **87,** 1379.

**1887–88.** 50,085 c. y. dredged by hired labor from bar at mouth of Calcasieu River, **88,** 1257.

**1888–89.** 27,074 c. y. dredged by hired labor, **89,** 1493.

**1892–93.** 1,104 l. f. jetty on east side of channel completed, and construction of 10,000 feet of revetment on north side of channel nearly completed, **93,** 1831.

**1893–94.** Revetment completed, 144,634 c. y. dredged, and about 5,000 l. f. east jetty built, **94,** 1374, 1375.

**1894–95.** East jetty completed to a total length of 7,347 l. f., 196,509 c. y. dredged, and 6,652 l. f. of east jetty capped, **95,** 1772.

**1895–96.** In connection with preceding year, 6,552 l. f. east jetty capped, and extension of east jetty in progress, **96,** 1510, 1511.

**1896–97.** In connection with preceding year, east jetty extended 500 l. f., and 2,200 l. f. west jetty constructed, **97,** 1769.

**1897–98.** 16,118 c. y. dredged and revetment repaired, **98,** 1480.

**1899–1900.** 7,777 s. y. mattress and 13,066 tons stone placed in west jetty, completing the extension, **1900,** 2266.

**Physical characteristics.**

Description of, **71,** 68, 557.

Refilling of the previously dredged channel, **85,** 1414; **86,** 1277; **87,** 1380.

Storms damaging works, **94,** 1374.

Effects of east jetty, **94,** 1375; **95,** 1772.

Depths, **97,** 1769.

**Plans.** (See *Projects.*)

By Maj. Heuer, channel 12 f. deep by dredging and protecting jetties across the bar; estimated $600,000, **87,** 1403.

**Projects.**

By Capt. Howell, 1871, improving bar at head of pass by dredging a channel 80 f. wide, 1½ m. long, and 5 f. deep, estimate $15,000, and, if extra dredge boat necessary, $25,000 to be added to estimate, **71,** 558; **72,** 61; **82,** 1387; **86,** 1277.

This work was accomplished in 1873–74, **74,** 73, 721.

In 1881 the previously dredged channel having closed, it was proposed to reopen it by the formation of a channel 70 f. wide and 8 f. deep at l. w. Estimate, $15,000, **81,** 1304; **86,** 1277.

By Maj. Howell, 1881, for improvement of river above the town of Lake Charles to Philips Bluff by cleaning channel of snags, logs, etc., to a navigable width and depth, and dredging bar at foot of Calcasieu Lake; estimate, $25,080, **81,** 196, 1302.

In 1886, the channel having again partly refilled, it was proposed to re-form a dredged channel 100 f. wide and 6 f. deep, protected by a pile-and-plank revetment on each side, **87,** 1379.

By Maj. Heuer, 1887, to obtain a 12 f. depth through the bar obstructing the passage from the Pass to the deep water of the Gulf with two converging jetties of brush mattress and riprap granite; estimate, $600,000, **87,** 1403, 1404.

By Maj. Quinn, 1894–95, dredging channels through bar at lake head, capping the east jetty with stone, and for dredging a channel 12 f. deep and as wide as funds would permit, from the 12-f. contour inside to the same contour outside, **95,** 1772.

Project submitted, 1899–1900, for extending the west jetty 1,000 f., **1900,** 2266.

**Surveys.**

Examination by Capt. Howell, **71,** 557.

Ordered by act of June 14, 1880, **80,** 146. Examination made by Maj. Howell, 1880, **81,** 1301.

Examination of lower reach of river, **83,** 1127.

Examination of bars at mouth of river and pass ordered by act of Aug. 5, 1886, made under direction of Maj. Heuer, **87,** 1402.

Examination ordered by act of Aug. 5, 1886, made, 1888, under direction of Capt. Fisk, **89,** 1527.

Maps. **94,** 1374; **95,** 1772; **97,** 1770; **99,** 1854; **1900,** 2268.

## CALIBOGUE SOUND. (See *Savannah River, Ga.*)

## CALIFORNIA DÉBRIS COMMISSION. (See *Feather, Sacramento, San Joaquin,* and *Yuba rivers.*)

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $10,000.00, | act Oct. 1. |
| 1893, | 15,000.00, | **94,** 3175. |
| 1896, | 15,000.00, | **96,** 3862. |
| 1897, | 15,000.00, | **97,** 3963. |
| 1897, | [a]111.70 (claims), | act July 19. |
| 1898, | 15,000.00, | **98,** 3551. |
| 1899, | 15,000.00, | **99,** 3749. |
| 1900, | 15,000.00, | **1900,** 5009. |
| Total, | 100,111.70 | |

**Engineers.**

CHIEF OF ENGINEERS. Reports, **94,** 421; **95,** 470; **96,** 421; **97,** 528; **98,** 530; **99,** 618; **1900,** 696.

ENGINEERS IN CHARGE:

Commission. Reports, **94,** 3169; **95,** 4049, 4062; **96,** 3861; **97,** 3961; **98,** 3569; **99,** 3747; **1900,** 5007.

Col. G. H. Mendell, 1894–95.

Lt. Col. Benyaurd, 1894–95; 1898–1900.

Maj. W. H. Heuer, 1894–95.

Col. C. S. Suter, 1896–98.

Maj. C. E. L. B. Davis, 1896–97.

Capt. C. E. Gillette, 1896–97.

Capt. H. Deakyne, 1898–1900.

Col. S. M. Mansfield, 1899–1900.

ASSISTANT. H. Vischer. Report, **1900,** 5035.

**Legal proceedings.**

Rules and instructions governing applicants for authority to mine, **94,** 3176.

Judicial proceedings and judicial decisions, **94,** 3180; **95,** 4056, 4066.

**Legislations.**

Acts of Congress and of the State of California relating to mining, **1900,** 5064.

**Operations.**

Synopsis of applications for authority to mine given in each annual report.

**Projects.**

Act of Mar. 1, 1893, created the commission with a view to its regulation of hydraulic mining in California. Its jurisdiction defined to extend to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems. **93,** 3169.

Project for impounding the mining débris, Yuba River, to improve the Sacramento and Feather rivers, **1900,** 5030. The plans provided for building various works in the Yuba River, at an estimated total cost of $800,000. One-half of this sum, 1900, appropriated by the United States, and one-half by California. **1900,** 5009.

## CALOOSAHATCHEE RIVER, FLA. (See *Orange River, Fla.*)

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $5,000, | **83,** 1004. |
| 1884, | 5,000, | **84,** 1196. |
| 1886, | 4,000, | **86,** 1153. |
| 1888, | 10,000, | **88,** 1095. |
| 1890, | 3,600, | **90,** 1599. |
| 1892, | 1,000, | **92,** 1378. |
| 1894, | 2,000, | **95,** 1550. |
| 1896, | 1,000, | **96,** 1328. |
| 1899, | 2,000, | **99,** 1626. |
| Total, | 33,600 | |

**Commerce.**

Benefit of improvement to commerce, **79,** 864, 866, 867, 869.

Orange River the only outlet for the large quantities of oranges grown in its vicinity, **97,** 1571.

In 1899–1900 the shipments of oranges and grape fruit amounted to $31,625, **1900,** 2036.

Description of, **1900,** 2034, 2036.

**Contracts.**

**1882.** S. N. Kimball, dredging, 62½ cents per c. y., **83,** 1004.

**1884.** S. N. Kimball, dredging, 69$\frac{9}{10}$ cents per c. y., **85,** 1274.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78,** 81; **79,** 106; **83,** 193; **84,** 201; **85,** 197; **86,** 196; **87,** 157; **88,** 146; **89,** 169; **90,** 151; **91,** 189; **92,** 187; **93,** 205; **94,** 190; **95,** 216; **96,** 193; **97,** 245, 251; **98,** 239; **99,** 278, 288; **1900,** 316, 326.

ENGINEERS IN CHARGE:

Capt. A. N. Damrell, 1878–84. **78,** 81; **79,** 105. Reports, **79,** 863; (Maj.), **83,** 1003; **84,** 1195.

Capt. W. T. Rossell, 1884–86. Report, **85,** 1273.

Lt. W. M. Black, 1886–92. Reports, **86,** 1152; **87,** 1235; (Capt.), **88,** 1093; **89,** 1337; **90,** 1596; **91,** 1643.

Maj. J. C. Mallery, 1892. Report **92,** 1377.

Lt. A. M. D'Armit, 1893. Report, **93,** 1660.

Maj. T. H. Handbury, 1894–95. Reports, **94,** 1233; **95,** 1549.

Lt. Col. W. H. H. Benyaurd, 1896–98. Reports, **96,** 1327; **97,** 1557, 1569; **98,** 1334.

Capt. H. Jervey, 1899–. Reports, **99,** 1625; **1900,** 2032, 2035.

Capt. T. H. Rees, 1900–. Report, **1900,** 2015.

[a] H. Doc. No. 182, 55th Cong., 2d sess.

## CALOOSAHATCHEE RIVER, FLA.—Continued.

ASSISTANTS:
J. L. Meigs. Report, **79**, 864.
J. W. Sackett. Report, **88**, 1095.
Lt. J. J. Meyler. Report, **97**, 1571.
O. Bie. Report, **94**, 1235.
W. H. Caldwell. Report, **1900**, 2037.
A. Thompson. Report, **1900**, 2038.

**Operations.**

**1883–84.** 6,905 c. y. dredged from bar at mouth, **84**, 1195.

**1885–86.** 5,000 c. y. dredged from channel near Fish Bayou, completing project, **86**, 1153.

**1886–87.** Removal of snags and similar obstructions in progress, **87**, 1236.

**1889–90.** 1,391 snags and 200 c. y. sand removed from the channel, and 584 overhanging trees from the banks; 1,300 piles sunk, 1,157 l. f. of waling and 242 c. y. brush protection placed, **90**, 1598.

**1890–91.** 9,044 c. y. sand and 330 snags cleared from the channel, and 1,800 trees cut from the banks; 18 c. y. rock blasted and 615 l. f. of training wall built, **91**, 1645.

**1893–94.** About 70 obstructions removed from banks and stream, **94**, 1235.

**1894–95.** Over 500 obstructions removed, **95**, 1550.

**1897–98.** About 400 obstructions removed, **98**, 1334.

**Physical characteristics.**

Description of, **79**, 864, 865, 866, 869; **88**, 1093; **91**, 1643.

Table of measurements and observations, **79**, 868.

Tide levels, **79**, 870.

Description of, Orange River, **97**, 1570; **1900**, 2033.

**Plans.** (See *Projects.*)

By J. L. Meigs, 1879, widening, deepening, and straightening channel from mouth to Fort Thompson, and cutting 6 miles of canals to reclaim lands subject to overflow; estimate, $148,978, **79**, 866.

For dredging and removing snags for channel 100 f. wide by 7 f. deep, mouth to Fort Myers; estimate, $19,094; **79**, 864, 869.

**Projects.** (See *Plans.*)

By Capt. Damrell, 1879, channel 100 f. wide and 7 f. deep by dredging and removal of snags, river mouth to Fort Myers, 14 miles; estimate, $20,000, **79**, 864, 869; **83**, 1003; **85**, 1273. Completed, 1886, at a cost of $14,000, **87**, 1236.

By Capt. Black, 1887, improvement Forts Myers to Thompson, for vessels drawing 4 f., by clearing the river of obstructions, and straightening and deepening the channel at Beautiful Plains; estimate, $13,647, **87**, 1236; **89**, 1338.

Project for improvement completed in 1892. Annual expenditure required for maintenance, $1,000, **92**, 1378.

Lt. Col. Benyaurd estimated, 1896, that an annual appropriation of $1,000, or a biennial one of $2,000, would be required for maintenance, **96**, 1328.

Capt. Jervey estimated, 1900, it would cost $2,500 for a channel in Orange River 4 f. deep and 50 f. wide to the head of navigation, with $500 annually for maintenance, **1900**, 2036.

**Surveys.**

Examination ordered and in progress, **78**, 81.

Examination completed by J. L. Meigs, **79**, 106, 864.

Surveys made, **87**, 1236.

Ordered by act of Aug. 5, 1886, made, 1888, under direction of Capt. Black, **88**, 1095.

Examination of Orange River, Fla., to its confluence with the Caloosahatchee, and thence to the Gulf of Mexico, ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd, 1896 (report favorable), **97**, 1571.

Examination and survey ordered by act of March 3, 1899, made 1899–1900, under direction of Capt. Jervey (report favorable) (see *Projects*), **1900**, 2033, 2035.

MAPS. **89**, 1338; **90**, 1598.

## CALUMET HARBOR, ILL.[a]

**Appropriations.**

| | | | |
|---|---|---|---|
| 1870[b] | $50,000, | **71**, | 36, 117. |
| 1871 | 50,000, | **71**, | 36. |
| 1872 | 40,000, | **72**, | 34. |
| 1873 | 40,000, | **73**, | 35. |
| 1874 | 25,000, | **74**, | 41. |
| 1875 | 25,000, | **75**, | 46. |
| 1876 | 20,000, | **76**, | 36, 99, 142. |
| 1878 | 15,000, | **78**, | 118. |
| 1879 | 12,000, | **79**, | 158. |
| 1880 | 20,000, | **80**, | 1989. |
| 1881 | 30,000, | **81**, | 2171. |
| 1882 | 35,000, | **82**, | 2242. |
| 1884 | 20,000, | **84**, | 1947. |
| 1886 | 10,000, | **86**, | 1704. |
| 1888 | 20,400, | **88**, | 1889. |
| 1890 | 20,000, | **90**, | 2405. |
| 1892 | 15,000, | **92**, | 2246. |
| 1894 | 15,000, | **95**, | 2703. |
| 1896 | 75,000, | **96**, | 2582. |
| 1899 | 150,000, | **99**, | 2835. |
| 1900 | 185,350, | **19**, | 3790. |
| Total, | 872,750 | | |

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[a] Survey.—Report, Dec. 1, 1836; estimates, $142,213.38. 1845 (map; no report). May 15, 1850; estimate, $115,445. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Appropriated for harbor of refuge at Chicago, Ill.

## CALUMET HARBOR, ILL.—Continued.

**Commerce.**

As harbor of refuge, **70**, 104; **76**. ii, 441.

Objections to improving harbor, **70**, 105.

Benefits of improvement, **73**, 215, 216; **76**, ii, 443, 444.

Local manufacturing interests, **73**, 215; **75**, 233; **76**, ii, 443.

Advantages to be derived from improvement, **80**, 1989.

Increase in manufacturing interests and tonnage from improvement, **90**, 2404.

Rapidly increasing, **93**, 2810; increase thought phenomenal, **95**, 2702, **96**, 2581.

The average size of vessels seeking the port in 1894–95 greater than at any other port in the world, **95**, 2773.

**Contracts.**

**1874.** W. S. Carkin, dredging, 17½ cents per c. y., **75**, 231.

**1875.** R. M. Steel, materials and labor, **75**, 232; **76**, ii, 438; John H. Gutches, dredging, **75**, 232; **76**, ii, 438.

**1879.** Culbert Brothers, pier, **80**, 1987; completed, **80**, 1987.

**1880.** G. Hannahs, pier extension, **81**, 2172; completed, **81**, 2169. O. B. Green, dredging, 15 cents per c. y., **81**, 2172; completed, **81**, 2160.

**1881.** Chicago Dredging and Dock Co., dredging, 26½ cents per c. y., **81**, 2172; completed, **81**, 2172.

**1883.** Walsh & Hannahs, pier extension, **83**, 1748; extended, **83**, 1748; completed, **84**, 1946. Calumet and Chicago Canal Dock Co., dredging, 28 cents per c. y., **83**, 1748: extended, **83**, 1748; completed, **84**, 1946.

**1886.** H. B. Herr & Co., pier extension, **87**, 2118.

**1888.** H. B. Herr & Co., pier extension, $8,954.70, **89**, 2118.

**1890.** W. A. McGillis & Co., dredging, 13½ cents per c. y., **91**, 2603.

**1892.** Wisconsin Dredge & Dock Co., crib work, piling, etc., $13,507.93, **93**, 2811.

**1894.** Fitz Simons & Connell Co., rebuilding superstructure of piers (timber, ironwork, stone, etc.), $7,419.30, **95**, 2705.

**1896.** N. G. Dodge & Son, dredging, 17.5 cents per c. y. ($4,812.50), **96**, 2583.

**1897.** Hausler & Lutz Towing & Dock Co., pier extension (timber, piles, ironwork, etc.), $36,438.73, **97**, 2806. Lydon & Drews Co., dredging, 9 cents per c. y. ($14,000), **97**, 2805. G. Cooper, rebuilding superstructure (timber, stone, ironwork, etc.), $4,128.20, **97**, 2807.

**1899.** Hausler & Lutz Towing & Dock Co., breakwater (timber, piles, ironwork, stone, dredging), $350,451.88, **99**, 2836.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 37, 123, 124; **71**, 35; **72**, 34; **73**, 35; **74**, 41, **75**, 46; **76**, 99; **77**, 103; **78**, 118; **79**, 158; **80**, 211; **81**, 286; **82**, 280; **83**, 288, 1748; **84**, 290; **85**, 313; **86**, 307; **87**, 273, **88**, 248; **89**, 288; **90**, 260; **91**, 330; **92**, 316; **93**, 361; **94**, 332; **95**, 369, 376; **96**, 325; **97**, 412; **98**, 402; **99**, 477; **1900**, 542.

BOARDS OF ENGINEERS:

Board reports that the improvement of Calumet River would not afford the relief needed by the crowded commerce of Chicago, and therefore recommend no plan for this purpose, **70**, 125; **76**, ii, 442. (Col. Macomb, Lt. Col. Raynolds, and Majs. Wheeler, Weitzel, and McFarland.)

Convened by S. O. No. 84, Corps of Engineers, 1882, Lt. Col. Houston, Majs. Smith and Benyaurd, **83**, 1748. (See *Projects.*)

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1870. Reports, **70**, 104.

Maj. W. E. Merrill, in temporary charge, 1870, **76**, ii, 442.

Maj. D. C. Houston, 1870–74. Reports, **71**, 117; **72**, 130; **73**, 215; **74**, 159.

Maj. G. L. Gillespie, 1874–77. Reports, **75**, 231; **76**, ii, 438.

Capt. G. J. Lydecker, 1877–81. Reports, **77**, 894; **78**, 1185; **79**, 1567; (Maj.), **80**, 1986; **81**, 2168.

Maj. W. H. H. Benyaurd, 1882–86. Reports, **82**, 2240; **83**, 1745; **84**, 1946; **85**, 2051; **86**, 1704.

Maj. T. H. Handbury, 1886–87. Report, **87**, 2117.

Capt. W. L. Marshall, 1888–99. Reports, **88**, 1888; **89**, 2116; **90**, 2404; **91**, 2602; **92**, 2245; **93**, 2810; **94**, 2138; (Maj.), **95**, 2701, 2771; **96**, 2580; **97**, 2801; **98**, 2425; **99**, 2833.

Maj. J. H. Willard, 1899–. Report, **1900**, 3788.

ASSISTANTS:

Capt. D. P. Heap, **70**, 104.

Lt. F. A. Hinman. Reports, **73**, 215; **74**, 159.

G. A. M. Liljencrantz. Reports, **82**, 2243; **89**, 2118; **90**, 2405; **91**, 2604; **92**, 2247; **93**, 2812; **94**, 2140; **95**, 2703; **96**, 2588; **97**, 2807; **98**, 2429; **99**, 2837; **1900**, 3791.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Wheeler, completion, $299,875.52, **70**, 105, 107; **76**, ii, 441.

By Capt. D. P. Heap, completion, $695,000, **70**, 105, 107; **76**, ii, 441.

By Capt. Lydecker, annual repairs, $5,000, **79**, 1569.

## CALUMET HARBOR, ILL.—Continued.

**Legislation.**

Act recommended by Board of Engineers, 1882, for protection of channel in Calumet River, **83**, 1750.

**Operations.**[a]

**1870–71.** 320 l. f. north crib pier built; 192 l. f. south crib pier built; 184 l. f. south pile pier built; cribs built at Chicago for this work, **71**, 35, 118; **76**, ii, 443.

**1871–72.** 384 l. f. north crib pier built; 320 l. f. north pier superstructure built; 256 l. f. south crib pier built; 475 l. f. south pile pier built, **72**, 34, 130; **76**, ii, 443.

**1872–73.** 464 l. f. north crib pier built; 228 l. f. south crib pier built; 570 l. f. south pile pier built; 384 l. f. south pier superstructure built; 49,720 c. y. dredged, **73**, 35, 215; **76**, ii, 443.

**1873–74.** 200 l. f. north crib pier built; 384 l. f. north pier superstructure built; 200 l. f. south crib pier built; 228 l. f. south pier superstructure built; 37,465 c. y. dredged, **74**, 41, 159; **76**, ii, 443.

**1874–75.** 150 l. f. north crib pier built; 350 l. f. north pier superstructure built; 100 l. f. south crib pier built; 300 l. f. south pier superstructure built; 49,874 c. y. dredged, **75**, 46, 231.

**1875–76.** 150 l. f. north pier superstructure built; 200 l. f. south crib pier built; 100 l. f. south pier superstructure built; 33,496 c. y. dredged; repairs, crib work by contract, superstructure by hired labor, **76**, 99, ii, 438.

**1876–77.** 13,886 c. y. dredged, **77**, 103, 895.

**1877–78.** 150 l. f. north crib pier built; cribs sunk on pile foundation; cribs on south pier refilled, **78**, 118, 1185.

**1878–79.** 200 l. f. north crib pier built; 200 l. f. north pier superstructure built; repairs, **79**, 1567.

**1879–80.** 200 l. f. pier extension, repairs to piers, and dredging through bar at entrance to harbor, **80**, 1987.

**1880–81.** 250 l. f. crib pier built; 14,547 c. y. dredged; minor repairs to piers, **81**, 2169.

**1882–83.** 11,007 c. y. dredged, 200 f. of crib work completed, and piles driven for pier foundation, **83**, 1745.

**1883–84.** Pier extension and dredging; 247 cords of stone purchased for refilling pier, **84**, 1946.

**1884–85.** South pier extended 200 l. f.; repair of 748 f. of plank revetment, **85**, 2051.

**1886–87.** South pier extended 150 f. Total work done since 1870: North pier extended 3,400 f.; south pier, 1,870 f.; 384,376 c. y. dredged, **87**, 2117.

**1888–89.** North pier completed to a length of 3,640 f.; south pier to a length of 2,020 f., **89**, 2117.

**1890–91.** 29,088 c. y. dredged, **91**, 2602.

**1891–92.** 57,930 c. y. dredged, **92**, 2246.

**1892–93.** 1,600 l. f. of superstructure of piers, etc., being rebuilt, **93**, 2810.

**1893–94.** Works of preceding year completed, **94**, 2138.

**1894–95.** Repair of 1,600 l. f. of superstructure of north and south piers in progress, **95**, 2701.

**1895–96.** Work of preceding years completed, **96**, 2580; and 5,200 c. y. dredged. **96**, 2581.

**1896–97.** 227,225 c. y. dredged; south pier extended 800 l. f., **97**, 2802, 2803; and the rebuilding of 500 l. f. of north pier commenced, **97**, 2803.

**1897–98.** Superstructure of north pier repairs commenced last year completed, **98**, 2426.

**1899–1900.** Outer breakwater under construction (drawings), **1900**, 3789.

**Physical characteristics.**

General, of Calumet River and tributaries, **70**, 104, 105; **95**, 2771; **96**, 2584.

Rocky reef 1½ miles north of piers and 2,800 f. from the shore, **70**, 105.

Advance of shore line 600 f. on the north side of the north pier and a recession of 180 f. alongside the south pier since 1870, **75**, 233; and from 1875 to 1877 a further advance on the north side of 200 f. and a further recession of 70 f. on the south side, **77**, 895.

A corresponding movement of the deep-water lines, **77**, 895.

Average annual advance of shore line north of piers, 115 f., 1870 to 1877, **77**, 895.

The Calumet larger than the Chicago River, **76**, ii, 441.

Harbor one of the harbors of the port of Chicago, **96**, 2584.

Drifting sand causing shoals, **96**, 2580; **1900**, 2834.

**Plans.** (See *Projects.*)

By Capt. Heap, 1869, piers and dredging to 18 f.; estimate, $695,000, **70**, 107.

Project of Maj. Wheeler and plan of Capt. Heap compared, **70**, 105; **76**, ii, 441.

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[a] History of operations to 1875, **76**, ii, 441. June, 1875, length of north pier, including pile work 2,869 l. f.; length of south pier, including revetment, 1,214 l. f.; **75**, 232.

Abstracts of materials used and work done, **75**, 232; **76**, ii, 438; **79**, 1567. Total length of piers, 4,260 f.; total dredging given as 280,000 c. y., **79**, 1568.

## CALUMET HARBOR, ILL.—Continued.

**Private (corporate) work.**

Improvement by the Calumet and Chicago Canal & Dock Co., **71**, 117.

Contractor for dredging and revetment, Charles Mears, **71**, 117, 118.

In 1895–96 the Illinois Steel Co. dredged a practicable 19-f. channel to its slip, **96**, 2581, and did more work of this character in the following year, **97**, 2803.

**Projects.**

By Maj. Wheeler, 1869, 2 parallel piers, 300 f. apart; dredging to 13½ f. in channel; estimate, $299,875. Conditions of recommendation, **70**, 104, 107; **76**, ii, 441, 442. Approved by the Chief of Engineers and adopted, **71**, 117.

By Maj. Wheeler, 1870, for forming a harbor by the extension of two parallel piers 300 f. apart and extended to at least the 12-f. curve; estimate, $300,000, **70**, 104, 107; **71**, 117; **76**, ii, 441, 442. Modified subsequently to provide a channel of entrance 16 f. deep and 30 f. wide, **80**, 211, 1988; **86**, 306.

By Maj. Gillespie, 1875, to extend the north pier to the 18-f. curve and the south pier to the 12-f. curve; dredging in channel, **75**, 232; **76**, ii, 438; **77**, 895.

By Board of Engineers, 1882, for dredged channel in Calumet River, 200 f. wide and 16 f. deep, from Lake Michigan to the fork at Calumet Lake; estimate, $225,000, **83**, 1750. (Lt. Col. Houston and Majs. Smith and Benyaurd.) Approved by the Chief of Engineers, **83**, 1748. In 1886, $392,000 having been appropriated, $11,400 estimated for completion of existing project, **86**, 307.

In 1888 Capt. Marshall estimated for the completion of the channel 16 f. deep and 300 f. wide between the piers, and the reconstruction of north and south pier superstructures, at a total of $43,500, **88**, 1889. Increased in 1889 to $47,000, **89**, 2117; and in 1890 to $67,000, **90**, 2405.

By Capt. Marshall, 1892, rebuilding part of the superstructure and revetments of the piers for a length of 1,600 l. f., **93**, 2810.

In 1895 Capt. Marshall estimated it would cost $154,550 to further improve the harbor, **95**, 2773, by extending the north pier 500 l. f. and the south pier 1,200 l. f., dredging between them to a depth of 20 f., the plan adopted by Congress, **96**, 2580.

In 1896 Capt. Marshall estimated it would cost $1,134,830 to improve the outer harbor, **96**, 2588.

Congress, 1899, placed the project under continuous contract, **99**, 2834.

By Maj. Marshall, 1899, for constructing an exterior breakwater first and for postponing dredging until the area to be dredged should be sheltered, **99**, 2834.

**Surveys.**

By Lt. Allen, 1836, **70**, 105; **76**, ii, 441.

By Capt. McClellan, 1845, **70**, 105; **76**, ii, 441.

Directed by Maj. Wheeler, made 1869 by Capt. Heap, **70**, 104; **76**, ii, 441.

Directed by Maj. Houston, made 1873 by Lt. Hinman, **73**, 215.

Directed by Capt. Lydecker, 1878–79, **79**, 1568.

Local survey made, **80**, 1987.

Survey of bar at mouth of Calumet River, **82**, 2240.

Miscellaneous surveys, **93**, 2810.

Survey of the harbor with a view to such additional improvement as might be required ordered by act of Aug. 17, 1894, report submitted by Capt. Marshall, 1895 (see *Projects*), **95**, 2771; additional report was submitted 1896 (see *Projects*), **96**, 2583.

Maps. Sketch of the harbor, June 30, 1879, **79**, 1568.

**80**, 1988; **83**, 1746; **84**, 1946; **85**, 2051; **89**, 2116; **90**, 2404; **91**, 2605; **92**, Atlas, 105, 106; **95**, 2704, 2772; **96**, 2588; **97**, 2808; **98**, 2430.

Drawings, outer breakwater, **99**, 2834.

## CALUMET HARBOR, LAKE WINNEBAGO, WIS.

**Commerce.**

In 1892 no general commerce, **93**, 2784.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 359.

ENGINEER IN CHARGE. Maj. J. F. Gregory, 1892–93. Report, **93**, 2783.

**Physical characteristics.**

Description of. The harbor is situated at the mouth of Pique Creek on the east shore of Lake Winnebago, used at times as a harbor of refuge by the smallest light-draft vessels, **93**, 2784.

**Survey.**

Examination ordered by act of July 13, 1892, made, 1892, by Maj. Gregory (report unfavorable), **93**, 2783.

## CALUMET RIVER, ILL. AND IND. (See *Grand Calumet River, Ill.*; *Lake Michigan.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1884,[a] | $50,000, | **84**, | 1948. |
| 1886, | 30,000, | **86**, | 1708. |
| 1888, | 50,000, | **88**, | 1896. |
| 1890, | 50,000, | **90**, | 2578. |
| 1892, | 75,000, | **92**, | 2252. |
| 1894, | 45,000, | **95**, | 2708. |
| 1896, | 50,000, | **96**, | 2593. |
| 1899, | 60,000, | **99**, | 2840. |
| Total, | 410,000 | | |

**Commerce.**

Vast commerce interested in, and to be affected by, improvement, **82**, 2248.

Description of manufacturing enterprises interested, **82**, 2255; **85**, 2062.

Description of, **93**, 2849, **95**, 2708.

Increasing, **95**, 2708.

Improvement of the river followed by a remarkable development of commerce, **99**, 479, 2839.

**Contracts.**

**1887.** S. O. Dixon, dredging, 11 cents per c. y., **88**, 1898.

**1888.** W. A. McGillis & Co., dredging, 11¾ cents per c. y., **89**, 2143.

**1889.** Burdick & McMahon, dredging, 22 cents per c. y., **89**, 2143.

**1890.** Wheeler & Russell, dredging, 12½ cents per c. y., **91**, 2607.

**1892.** Wisconsin Dredge & Dock Co., dredging, 13.7 cents per c. y. ($12,330). Sheboygan Dredge & Dock Co., dredging, 10.7 cents per c. y. ($42,800). **93**, 2818.

**1894.** W. A. McGillis & Co., dredging, 16½ cents per c. y. McMahon & Montgomery Co., dredging, 12.9 cents per c. y. (annulled by supplementary agreement, **95**, 2707). **95**, 2709.

**1896.** C. E. Mitchell & Co., dredging, 13¼ cents per c. y. ($42,400), **97**, 2812.

**1899.** Fitz Simons & Connell Co., dredging, 16 cents per c. y. ($40,000), **99**, 2840.

**Engineers.**

Chief of Engineers. Reports, **81**, 287; **82**, 282; **84**, 290, 291; **85**, 314, 315; **86**, 308; **87**, 275, 277; **88**, 250; **89**, 290; **90**, 262; **91**, 331; **92**, 317; **93**, 361, 366; **94**, 333; **95**, 370; **96**, 326; **97**, 414; **98**, 403; **99**, 478; **1900**, 544.

Board of Engineers. Convened at Chicago, Oct. 6, 1882, by S. O. No. 84, C. E., to report upon proposed improvement of Calumet River, **83**, 1748 (Lt. Col. Houston and Majs. Smith and Benyaurd).

Engineers in Charge:

Maj. W. H. H. Benyaurd, 1881–86. Reports, **82**, 2247; **83**, 1745; **84**, 1947, 1951; **85**, 2055, 2057, 2059; **86**, 1707; **87**, 2172.

Maj. T. Handbury, 1886–87. Report, **87**, 2167.

Capt. W. L. Marshall, 1888–99. Reports, **88**, 1896; **89**, 2142; **90**, 2576; **91**, 2606; **92**, 2249; **93**, 2815; **94**, 2143; (Maj.) **95**, 2706; **96**, 2590; **97**, 2810; **98**, 2430; **99**, 2838.

Maj. J. H. Willard, 1899–. Report, 1900, 3792.

Assistant. G. A. M. Liljencrantz. Reports, **82**, 2251; **85**, 2061; **89**, 2145; **90**, 2578; **91**, 2609; **92**, 2252; **93**, 2818; **94**, 2146; **95**, 2709; **96**, 2594; **97**, 2813; **98**, 2433; **99**, 2840; **1900**, 3795.

**Legal proceedings.**

Right of way and releases from claims for damages secured by the U. S., **99**, 2838. (See *note to title.*)

**Obstructions.**

Three bridges crossing the stream, belonging to the Baltimore and Ohio, the Pennsylvania, and the Lake Shore railroads, respectively, obstructions, **97**, 2811.

**Operations.**

**1887–88.** 76,800 c. y. dredged, **88**, 1897.

**1888–89.** 34,523 c. y. dredged, **89**, 2576.

**1889–90.** 354,017 c. y. dredged, **90**, 2576.

**1890–91.** 72,111 c. y. dredged, **91**, 2607.

**1891–92.** 293,608 c. y. dredged, **92**, 2249.

**1892–94.** 513,442 c. y. dredged, **93**, 2816; **94**, 2144.

**1894–95.** Over 171,668 c. y. dredged, **95**, 2707.

**1895–96.** 22,451 c. y. dredged, **96**, 2594.

**1896–97.** 222,400 c. y. dredged, **97**, 2811.

**1897–98.** 98,178 c. y. dredged, **98**, 2432,

**1899–1900.** 179,655 c. y. dredged (drawing), **1900**, 3794.

**Physical characteristics.**

Description of, **93**, 2816, 2846; **97**, 2811.

Channel subject to considerable deterioration by filling with refuse, etc., **94**, 2144; **98**, 2432.

In 1895 it was impossible for the contractors for dredging above the Forks to get and maintain the necessary depth long enough to have it measured and received on account of the inflow of sewage

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[a] Proviso to act states that no part of the appropriation shall be expended until right of way should be conveyed to the United States free of cost.

## CALUMET RIVER, ILL. AND IND.—Continued.

matter, etc., which filled the channel immediately, **96**, 2592.

In 1896 the channel between the Forks and Hammond rapidly filling, and in a worse condition than when improvement of it began, **96**, 2592; **99**, 2839; **1900**, 3793.

Table showing redredging necessary, **1900**, 3797.

**Projects.**

By Board of Engineers, 1882, improvement of the lower section of Calumet River from Lake Michigan to the Forks, 6½ miles, by dredging channel 200 f. wide and 16 f. deep; estimate, $225,000, **83**, 1748, 1749, 1750; **86**, 308.

In 1885 Maj. Benyaurd proposed the extension of the improved channel from the Forks to a point half a mile east of Hammond, at an additional cost of $200,000, **85**, 2061; making the entire estimate $425,000, **87**, 2167, 2170.

By Capt. Marshall, 1889, dredging Calumet River to secure a channel from its mouth to one-half mile east of Hammond, 16 f. deep and 200 f. wide throughout; estimate, $1,000,000, or $870,000 for completion, **89**, 2144; **91**, 2608.

Congress allowed the appropriation of 1896 to be expended for securing a depth of 20 f. for 2 miles above the mouth of the river by dredging, **96**, 2593.

Congress, 1899, confined work under appropriation of 1899 to that part of the river between the mouth and the Forks, **99**, 479.

**Surveys.**

Ordered by act of Mar. 3, 1881; made, 1882, under direction of Maj. Lydecker, **82**, 2247; **84**, 1951.

Examination of Little Calumet River ordered by act of Aug. 2, 1882; made, 1882, under direction of Maj. Lydecker (report unfavorable), **84**, 1952.

Examination for a ship canal from Calumet River to Lake Calumet ordered by act of July 5, 1884; made, 1884, under direction of Maj. Benyaurd (report unfavorable), **85**, 2057.

Examinations from Lake Calumet to Blue Island ordered by act of Aug. 5, 1886, made under direction of Maj. Benyaurd (report unfavorable), **87**, 2172.

Examination from the Forks to Hammond ordered by act of July 5, 1884, made under direction of Maj. Benyaurd, **85**, 2059.

Survey made, 1889, under direction of Capt. Marshall, **89**, 2147.

Examination for an outer harbor at the mouth of the river ordered by act of July 13, 1892; report (favorable) submitted, 1893, by Capt. Marshall, **93**, 2846.

MAPS, **82**, 2251; **89**, 2142; **90**, 2578; **91**, 2610; **92**, Atlas, 107, 108; **93**, 2848; **94**, 2148; **95**, 2712; **96**, 2596; **97**, 2814; **98**, 2430, 2432.

DRAWINGS. (See *Operations for 1900.*)

## CALUMET RIVER TO LAKE CALUMET, ILL. (Ship canal.)

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 315.

ENGINEER IN CHARGE. Maj. W. H. H. Benyaurd. Report, **85**, 2057.

**Private (town) work.**

Improvement made by town of Hyde Park, **85**, 2058.

**Survey.**

Ordered by act of July 5, 1884, **85**, 314; made under the direction of Maj. Benyaurd, 1884 (report unfavorable), **85**, 2057.

## CAMBRIDGE HARBOR, MD. (See *Choptank River, Md.*)

**Appropriations.**

| | | |
|---|---|---|
| 1871, | $10,000, | **71**, 75, 615. |
| 1872, | 10,000, | **72**, 68, 687; **73**, 72. |
| 1873, | 5,000, | **73**, 72, 765; **74**, 82, ii, 24. |
| 1878, | 5,000, | **78**, 175; **79**, 501. |
| 1879, | 2,500, | **79**, 76, 501. |
| 1888, | 5,000, | **88**, 93. |
| 1890, | 5,000, | **90**, 940. |
| 1892, | 7,737, | **92**, 974. |
| Total, | 50,237 | |

**Commerce.**

Important, **97**, 1297.

**Contracts.**

**1871.** G. H. Ferris, dredging, 27 cents per c. y., **71**, 615; **72**, 687.

**1872.** G. H. Ferris, dredging, 18¾ cents per c. y., **73**, 765.

**1873.** A. A. Dodge, dredging, 27 cents per c. y., **73**, 765; **74**, ii, 24.

**1878.** G. H. Ferris, dredging, 13¾ cents per c. y., s. m., and 10 cents per c. y. thrown behind bulkheads, **79**, 501.

**1884.** American Dredging Co., dredging, **84**, 902; completed, **85**, 888.

**1889.** C. T. Caler, dredging, 18½ cents per c. y., **89**, 904.

## CAMBRIDGE HARBOR, MD.—Continued.

**1892.** American Dredging Co., dredging, 9.4 cents per c. y., s. m., **93**, 1219.

**1895.** Baltimore Dredging Co., dredging, 19.8 cents per c. y., p. m., **95**, 1138.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 32, 70; **71**, 75; **72**, 68; **73**, 72; **74**, 82; **75**, 87; **76**, 63; **79**, 76; **80**, 103; **81**, 137; **82**, 132; **83**, 137; **84**, 144; **85**, 135; **87**, 97; **88**, 93; **89**, 110; **90**, 101; **91**, 127; **92**, 127; **93**, 139; **94**, 128; **95**, 145; **96**, 133; **97**, 172.

ENGINEERS IN CHARGE:

Col. J. H. Simpson. Report, **70**, 421.

Maj. Wm. P. Craighill, 1871–85, **71**, 71, 585. Reports, **71**, 614–620; **72**, 687; **73**, 765; **74**, ii, 24; **75**, ii, 68; **76**, 288; **79**, 500; **80**, 637; (Lt. Col.), **81**, 879; **82**, 853; **83**, 678; **84**, 902.

W. F. Smith, U. S. agent, 1885–97. Reports, **85**, 888; **87**, 851, 853; (Maj.) **89**, 902; **90**, 940; **91**, 1191; **92**, 973; **93**, 1218, **94**, 895; **95**, 1136; **96**, 965; **97**, 1296.

ASSISTANTS:

W. Popp. Report, **71**, 66.

C. J. Bates, **71**, 616.

C. Humphreys. Report, **87**, 852.

**Estimates.** (See *Projects.*)

By Wm. Popp, adopted by Maj. Craighill, dredging entrance way at the mouth and a basin abreast of Cambridge, if 10 f. deep, $36,000; $21,600 if 8 f. deep, **71**, 614, 616, 618; **74**, 82, ii, 24.

**Legislation.**

Company chartered by Maryland, 1868, for improvement of the harbor, etc., petitioned to have their charter confirmed by the United States, **71**, 619.

**Obstructions.** (See *Projects.*)

**Operations.**

**1870–71.** Dredging by contract in progress, **71**, 75, 615.

**1871–72.** Dredging ceased the last day of August for want of funds, **72**, 68, 687.

**1872–73.** Dredging commenced Sept. 10. Width of entrance was increased from 50 f. to 100 f., and nearly all of the inner basin was dredged to a depth of 8 f., **73**, 72, 765.

**1873–74.** Dredging ceased Aug. 11, 1873; entrance widened to 125 f., **74**, 82, ii, 24.

**1878–79.** Dredging by contract in the inner harbor and approaches, **79**, 76, 501.

**1883–84.** Enlargement of harbor by dredging to extent of available funds, **84**, 902; **85**, 888.

**1888–89.** 23,000 c. y. dredged, **89**, 902.

**1892–93.** 42,744 c. y., s. m., dredged, **93**, 1218.

**1893–94.** 11,862 c. y., s. m., dredged, **94**, 895.

**1894–95.** 26,429 c. y., p. m., dredged, and the project completed, **95**, 1137.

**Physical characteristics.**

Description of, **71**, 616–620; **79**, 500; **84**, 144.

Until protective works are constructed the channel across the bar will have a tendency to fill so as to require redredging, **96**, 965.

**Plans.** (See *Projects.*)

By W. F. Smith, 1887, for dredged channel 150 f. wide and 12 f. deep to the railroad wharf, 10 f. to the drawbridge, and 8 f. to the head of the wharfage. Estimate $17,136. **87**, 853.

**Private work.**

About $8,000 was raised and expended by the citizens in 1869 in dredging and building a jetty, **71**, 617. Results, **79**, 501.

**Projects.**

By Maj. Craighill, 1871, for dredging a channel of entrance to Choptank Creek and a basin 8 f. deep abreast of Cambridge, **74**, ii, 24. Modified in 1874 for enlargement of basin and channel leading thereto, **79**, 501. Amount appropriated from 1871 to 1879, inclusive, $32,500, **87**, 852.

In 1890, after an expenditure of $42,500, $7,736 was estimated as required for completion of existing project, **90**, 940, 941; **91**, 1193.

By Maj. Smith, 1893, for the expenditure of as much of the available funds as might be needed for dredging in Cambridge Harbor below the bridge in accordance with a proviso in the act of July 13, 1892, that no money should be expended on this improvement above the bridge until the draw in it should be widened to accommodate the commerce of the river, **93**, 1218. The Secretary of War, in 1894–95 approved the plans of the Dorchester County, Md., commissioners for alteration of the bridge, providing for a draw opening of 49 f. 1½ in., **95**, 1137.

Maj. Smith, 1896, estimated that the total cost of completing the improvement would be $8,120, **97**, 1297.

**Surveys.**

Ordered by act approved July 11, 1870, assigned to Col. Simpson, and made under his direction in Oct., 1870, by Wm. Popp, assisted by C. J. Bates. Reports, **71**, 614, 620.

## CAMBRIDGE HARBOR, MD.—Continued.

Resurvey of harbor and approaches, **80**, 638.

Ordered by act of Aug. 5, 1886, made under direction of Maj. Smith, **87**, 851, 853.

Survey ordered by act of June 3, 1896, made 1896, by Maj. Smith (report favorable; see *Projects*) **97**, 1297.

MAPS. Of Wm. Popp's survey, mentioned, **71**, 615.

## CAMDEN HARBOR, ARK. (See *Ouachita River.*)

## CAMDEN HARBOR, ME.

**Appropriations.**

1873, $10,000, **73**, 97.
1874, 10,000, **74**, 107.
1875, 10,000, **75**, 114.
1888, 5,000, **89**, 523.
1890, 6,000, **90**, 436.
1892, 12,000, **92**, 510.
1894, 12,000, **95**, 554.
1896, 10,000, **96**, 556.

Total, 75,000

**Commerce.**

Shipbuilding and manufacturing interests, **88**, 403, 404.

Description of, **1900**, 1112.

**Contracts.**

**1873.** F. Mead, dredging, 40 cents per c. y., **73**, 1062.

**1874.** A. Wright, dredging, 28 cents per c. y., **74**, ii, 302.

**1875.** A. Wright, dredging, 18 cents per c. y., **75**, ii, 390.

**1889.** E. P. Lovering, dredging, 25 cents per c. y., **89**, 524.

**1892.** Hamilton & Sawyer, dredging, 25¾ cents per c. y., s. m. ($15,450), **93**, 690.

**1895.** Hamilton & Sawyer, dredging, 19¼ cents per c. y., s. m. ($11,550), **95**, 554.

**1896.** Hamilton & Sawyer, dredging, 14¾ cents per c. y., s. m. ($8,850), **97**, 782.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 97, 106; **74**, 107; **75**, 114; **76**, 40; **88**, 14, 22; **89**, 23; **90**, 19; **91**, 24; **92**, 28; **93**, 27; **94**, 26; **95**, 28; **96**, 30; **97**, 32; **99**, 62; **1900**, 63.

ENGINEERS IN CHARGE:

Lt. Col. Thom, 1872–1876; **73**, 93; **74**, 103; **75**, 111; **76**, 37. Reports, **73**, 1062, 1106; **74**, ii, 302; **75**, ii, 390; **76**, 156.

Lt. Col. J. A. Smith, 1888–92. Reports, **88**, 403; **89**, 523; **90**, 436; **91**, 587.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 509; **93**, 689; **94**, 505.

Lt. Col. D. P. Heap, 1895. Report, **95**, 553.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 554.

Maj. R. L. Hoxie, 1897. Report, **97**, 782.

Maj. S. W. Roessler, 1900–. Reports, **1900**, 1111, 1114.

ASSISTANTS:

A. C. Both. Reports, **73**, 1107; **1900**, 1115.

F. S. Burrowes. Report, **88**, 406.

**Operations.**

**1873–74.** 22,753 c. y. dredged, forming a channel 2,000 f. long, 50 f. wide, and 7 f. deep from deep water to eastern wharves, **74**, 107, ii, 302.

**1874–75.** Dredging under contract, **75**, 114, ii, 390.

**1875–76.** 82,199 c. y. dredged from channel, completing project, **76**, 40, 157. Total amount dredged, 104,952 c. y., **76**, 40, 157.

**1889–90.** 18,045 c. y. dredged, **90**, 436.

**1891–92.** 30,664 c. y. dredged, **92**, 510.

**1893–94.** About 42,000 c. y. dredged; 11 bowlders obstructing entrance removed at a cost of $550, **94**, 506.

**1895–96.** About 56,000 c. y. dredged, **96**, 555.

**1896–97.** About 62,000 c. y. dredged; project completed, **97**, 782.

**Physical characteristics.**

Soundings, **73**, 1108.

Description of, **1900**, 1114.

**Projects.**

By Lt. Col. Thom, 1872, excavating a channel 100 f. by 7 f. at m. l. w. to head of wharves on the eastern side of harbor, 1,000 f. long; on western side a channel 80 f. by 3 f. by 1,400 f. to wharves; further to regulate the entrances to these channels by dredging between wharves, **73**, 97, 1062, 1108; **74**, 107, ii, 302; **75**, 114. Second channel modified to 7 f. depth, **76**, 157.

By Lt. Col. Smith, 1888, improvement of channel and harbor areas by deepening two areas to 10 and 12 f. m. l. w., respectively, and the excavation of Channel C 100 f. wide and Channel D 50 f. wide, both to be 10 f. in depth; estimate, $59,930, **88**, 405, 406; increased in 1890 to $60,000, **90**, 436; **91**, 588; **92**, 509.

By Maj. Roessler, 1900, dredging the area in front of the Boston and Bangor Steamship Co.'s wharf to 14 f. depth at m. l. w.; estimate, $7,400, **1900**, 1114.

**Surveys.**

By A. C. Both, 1872, **73**, 97, 1062, 1106.

Ordered by act of Aug. 5, 1886, made, 1888, under direction of Lt. Col. Smith, **88**, 405.

Examination and survey ordered by act of Mar. 3, 1899, made under direction of Maj. Roessler, 1899 (no improvement of inner harbor recommended; outer harbor improvement recommended), **1900**. 1111, 1114.

## CAMDEN HARBOR, N. J. (See *Delaware River at Philadelphia, Pa.*)

## CANALS, ROADS AND. (See *Examinations, etc.*)

## CANAPITSIT CHANNEL, MASS.

**Appropriations.**
1892, $4,800, **93**, 821.
1894, 5,000, **95**, 673.

Total, 9,800

**Contracts.**
**1895.** Hartford Dredging Co., dredging, 36 cents per c. y. ($3,500), **95**, 673.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **91**, 62; **92**, 66; **93**, 59; **94**, 54; **95**, 60; **96**, 59; **97**, 71; **98**, 74; **99**, 86.

ENGINEERS IN CHARGE:
Capt. W. H. Bixby, 1892–95. Reports, **92**, 645; **93**, 820; **94**, 584; **95**, 672.
Maj. W. R. Livermore, 1892. Report, **92**, 645.
Maj. D. W. Lockwood, 1896–99. Reports, **96**, 640; **97**, 900; **98**, 908; **99**, 1117.

**Operations.**
**1892–93.** About 3,300 c. y. dredged, and 1,155 tons of bowlders removed, **93**, 820.
**1893–94.** Removal of bowlders in progress, **94**, 584.
**1897–98.** 5,638 c. y. dredged; about 90 c. y. of bowlders removed. Project completed, **98**, 908.

**Physical characteristics.**
Description of, **93**, 820.

**Projects.**
In 1891 by Maj. Livermore to secure depth of 6 f. with width of 250 f., estimate $4,800, **93**, 820. Estimate increased, 1893, to $9,800, **93**, 821.
By Capt. Bixby, 1893, for doing work with hired labor and Government plant. **93**, 820.
By Capt. Bixby, 1895, for dredging by contract. **95**, 672.

**Survey.**
Survey of the channel, between Cuttybunk and Nashawena islands, made, 1891, under direction of Maj. Livermore, **92**, 646.
MAPS. **93**, 820, **95**, 672.

## CANARSIE BAY. (See *Long Island Coast.*)

**Appropriations.**
1880, $10,000, **80**, 515.
1881, 5,000, **81**, 650.
1882, 3,000, **82**, 670.
1884, 5,000, **84**, 732.
1886, 10,000, **86**, 748.
1888, 10,000, **88**, 628.
1890, 5,000, **90**, 841.
1892, 5,000, **92**, 867.
1894, 2,000, **95**, 967.
1896, 10,000, **96**, 753.

Total, 65,000

**Commerce.**
Increased business through restoration of channel, **81**, 651.
Benefit of improvement, **83**, 565.
Fishing industry of the bay, **88**, 628; large, **94**, 795.

**Contracts.**
**1880.** Henry Du Bois & Sons, pile dike, **81**, 650; completed, **81**, 651.
**1881.** E. Brainard, dredging, 50 and 40 cents per c. y., **83**, 565; completed, **83**, 564.
**1884.** Henry Du Bois & Sons, dredging and diking, 30 cents per c. y., and $29.37 per l. f. respectively, **85**, 740; completed, **85**, 739.
**1888.** S. A. Kelly, pile dike construction, $9.87 per l. f., **88**, 629.
**1891.** E. Brainard, dredging, 24 cents per c. y., **91**, 980.
**1893.** J. H. Fenner, dredging, 24 and 40 cents per c. y. ($4,000), **93**, 1102.
**1896.** E. Brainard, dredging, 28 cents per c. y., s. m. ($10,000), **97**, 1116.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 84; **81**, 104; **82**, 105; **83**, 103; **84**, 108; **85**, 98; **86**, 101; **87**, 64; **88**, 65; **89**, 84; **90**, 75; **91**, 95; **92**, 98; **93**, 106; **94**, 96; **95**, 108; **96**, 89; **97**, 125; **98**, 120; **99**, 139; **1900**, 156.

ENGINEERS IN CHARGE:
Col. J. Newton, 1878–83. Reports, **80**, 514; **81**, 649; **82**, 669.
Lt. Col. G. L. Gillespie, 1883–86. Reports, **83**, 564; **84**, 731; **85**, 739.
Lt. Col. W. McFarland, 1886–89. Reports, **86**, 746; **87**, 737; **88**, 627.
Capt. T. L. Casey, 1889–94. Reports, **89**, 816; **90**, 839; **91**, 980; **92**, 866; **93**, 1101; **94**, 795.
Lt. Col. G. L. Gillespie, 1895. Report, **95**, 966.
Maj. H. M. Adams, 1896–98. Reports, **96**, 751; **97**, 1114; **98**, 1014.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1245.
Maj. E. H. Ruffner, 1900–. Report, **1900**, 1415.

**Operations.**
**1880–81.** 1,000 l. f. of timber dike built, **81**, 649.

## CANARSIE BAY—Continued.

**1882–83.** 9,726 c. y. dredged, **83,** 564.

**1884–85.** 7,535 c. y. dredged and 50 f. added to east end of dike, **85,** 739.

**1887–88.** 2,946 c. y. dredged, 590 l. f. of piling driven, and 30 f. of dike timbered and prepared for stone filling, **88,** 626.

**1888–89.** 33,320 c. y. dredged, 820 f. of dike built, **89,** 817.

**1891–92.** 12,760 c. y. dredged; repairs to north dike, **92,** 866.

**1892–93.** 7,867 c. y. dredged, **93,** 1101.

**1893–94.** About 3,000 c. y. dredged, **94,** 795.

**1895–96.** North dike slightly repaired, **96,** 752.

**1896–97.** 35,714 c. y. dredged, **97,** 1115.

**Physical characteristics.**

Description of, **88,** 627; **96,** 751.

Bay is the northwest part of Jamaica Bay at and in front of Canarsie Landing. Jamaica Bay is about 6 miles east and west by 4 miles north and south, connecting with Atlantic Ocean through Rockaway Inlet, in the southern part of Long Island, and is 7 miles from the Narrows, New York Harbor. **96,** 751.

**Projects.**

By Col. Newton, 1879, channel of entrance into Canarsie Bay, of navigable width and not less than 6 f. depth, through the aid of dikes inclosing a tidal basin; estimate, $88,000, **79,** 400; **80,** 84; **82,** 670; **91,** 981; **92,** 866.

**Surveys.**

Canarsie Bay.

MAPS. **82,** 670.

## CANAVERAL HARBOR, FLA. (See *Cape Canaveral, Fla.*)

## CANE RIVER, LA. (See *Pierre Bayou.*)

**Appropriation.**

**1884.** $2,500, **85,** 1496.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84,** 227; **85,** 233; **86,** 230; **87,** 194; **91,** 249; 2022.

ENGINEERS IN CHARGE:

Capt. A. M. Miller, 1882–85. Report, **84,** 1366.

Capt. E. Bergland, 1885–86. Reports, **85,** 1495; **86,** 1349.

Capt. J. H. Willard, 1886–91. Reports, **87,** 1452; **91,** 2022.

ASSISTANT. P. C. Montgomery. Report, **84,** 1367.

**Operations.**

**1884–85.** 2,504 shore and channel snags removed, 4,517 trees and stumps cut, and 1,250 c. y. rock blasted, **85,** 1495.

**Physical characteristics.**

Described, **84,** 1367.

**Projects.**

By Capt. Miller, 1882, removing obstructions from head to mouth, to allow navigation six months in the year. Estimate, $7,665, **84,** 1368; **87,** 1452.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made, 1883, under direction of Capt. Miller, **84,** 1366.

Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Willard (report unfavorable to slack-water improvement), **91,** 2022.

## CANEY CREEK, TEX.

**Commerce.**

Small, and no increase expected, **89,** 1581.

Farm products the principal articles of commerce, **1900,** 2457.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89,** 207; **1900,** 397.

ENGINEERS IN CHARGE:

Maj. O. H. Ernst, 1888–89. Report, **89,** 1580.

Capt. C. S. Riché, 1899–. Reports, **1900,** 2453, 2455.

ASSISTANTS:

R. B. Talfor. Report, **89,** 1581.

S. M. Wilcox. Report, **1900,** 2457.

**Physical characteristics.**

Caney Creek at one time emptied into the Gulf of Mexico; now empties into Matagorda Bay, **1900,** 2454.

Description of, **1900,** 2457.

**Projects.**

Capt. Riché estimated, 1900, it would cost $20,000 to make the improvement as a part of an inland light-draft navigation system, **1900,** 2456.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Ernst (report unfavorable), **89,** 1580.

Examination and survey ordered by act of Mar. 3, 1899, made, 1899–1900, under direction of Capt. Riché (report favorable; see *Projects*), **1900,** 2454, 2455.

## CANEY FORK RIVER, TENN. (including an examination of Obey River, Tenn.). (See *Obey River*.)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $6,000, | **80**, | 1689. |
| 1881, | 4,000, | **81**, | 1870. |
| 1882, | 4,000, | **82**, | 1855. |
| 1884, | 3,000, | **84**, | 1654. |
| 1886, | 3,000, | **86**, | 1524. |
| 1888, | 2,500, | **88**, | 1634. |
| 1890, | 2,500, | **90**, | 2150. |
| Total, | 25,000 | | |

**Commerce.**

Benefit to commerce by improvement, **79**, 1275, 1277, 1278, 1279.

Merchandise transported on river, **84**, 1654; **88**, 1635.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 105; **79**, 142; **80**, 188; **81**, 254; **82**, 248; **83**, 256; **84**, 256; **85**, 278; **86**, 269; **87**, 235, 236; **88**, 212; **89**, 247; **90**, 223; **91**, 284; **92**, 272; **93**, 306; **94**, 282; **95**, 309.

ENGINEERS IN CHARGE:

Capt. W. R. King, 1878–86, **78**, 105; **79**, 142. Reports, **79**, 1275; (Maj.), **80**, 1688; **81**, 1869; **82**, 1854; **83**, 1499; **84**, 1653; **85**, 1768, 1774.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86**, 1523; **87**, 1766, 1768; **88**, 1634; **89**, 1847; **90**, 2149; **91**, 2284.

Lt. Col. H. M. Robert, 1892. Report, **92**, 1941.

Capt. J. Biddle, 1893–95. Reports, **93**, 2402; **94**, 1818; **95**, 2264.

ASSISTANTS:

C. A. Turrill. Reports, **79**, 1275, 1277.

C. A. Locke. Report, **87**, 1769.

**Obstructions.** (See *Physical characteristics.*)

**Operations.**

**1880–81.** 91 c. y. rock, 2,368 c. y. gravel, and 3,956 logs, snags, etc., removed from channel; 555 c. y. stone placed in dams, and 260 l. f. of wing dam built, **81**, 1870.

**1881–82.** 2,598 c. y. log and stone dams built, 200 c. y. gravel and loose rock excavated, and 2,196 trees and snags removed, **82**, 1854.

**1882–83.** 365 trees, snags, and stumps cut down and removed, 775 c. y. gravel put in dams, and 250 c. y. stone quarried for dam, **83**, 1500.

**1883–84.** 347 c. y. stone quarried, 1,735 c. y. riprap dam built, and 2,595 c. y. rock and gravel excavated from channel; 928 trees, stumps, and snags removed, **84**, 1653.

**1884–85.** 600 c. y. rock quarried and placed in riprap dams, 310 l. f. riprap dam built, 2,595 c. y. gravel and loose rock excavated, and 1,609 trees, stumps, and snags removed, **85**, 1769.

**1887–88.** 1,550 c. y. rock, sand, and gravel excavated; 593 c. y. riprap stone quarried; 568 l. f. spur riprap dams built; 219 snags removed from the channel and 4,151 trees from the banks, **88**, 1635.

**1888–89.** 15 c. y. rock and 28 snags removed from the channel; 1,316 c. y. riprap stone quarried, **89**, 1848.

**1889–90.** 4 snags removed, 65 bowlders and 388 c. y. stone quarried, and 1,223 c. y. riprap dam built, **90**, 2150.

**1890–91.** 4,787 trees cut, and 49 snags and 440 c. y. rock removed from the channel, **91**, 2285.

**1891–92.** 30 c. y. rock, 227 snags, and 5,969 overhanging trees removed from the channel and banks, **92**, 1941.

**Physical characteristics.**

Description of, **79**, 1276, 1277, 1279.

List of obstructions, **79**, 1276, 1278.

**Plans.** (See *Projects.*)

By C. A. Turrill, 1879, improving Caneys Fork ($30,228) and Obeys River ($11,869) by dredging, excavating rock, and building riprap dams, **79**, 1276–1279.

**Projects.** (See *Plans.*)

By Capt. Overman, 1878, formation of a navigable channel during five months of the year from the mouth to Slingo by removal of obstructions, dredging and rock removal, and the construction of riprap dams; estimate, $30,228, **79**, 1275, 1277; **83**, 1500; **87**, 1767.

By Lt. Col. Barlow, 1886, extending navigation, Slingo to Franks Ferry; estimate, $15,000, entire estimate, $45,000, **87**, 1767, 1769; **92**, 1941.

**Surveys.**

Examination ordered and in progress, **78**, 105.

Examination completed by C. A. Turrill, **79**, 142, 1275, 1277,

Examination with view to extension of Caney Fork River survey to Franks Ferry, made 1884, under direction of Maj. King, **85**, 1774.

Examination ordered by act of Aug. 5, 1886, made under direction of Lt. Col. Barlow, **87**, 1768.

## CANNASANIER. (See *Lake Cannasanier; Tones Bayou.*)

## CANNON RIVER, MINN. (Reservoirs.) (See also *Mississippi River, reservoirs at headwaters of.*)

**Commerce.**
Statistics, **67**, 263.

**Engineers.**
Chief of Engineers. Reports, **66**, ii, 41, iii, 36; **81**, 247; **82**, 242; **84**, 250.

Engineers in Charge:
Maj. G. K. Warren, **66**, ii, 41. Reports, **67**, 259, 262, 263.
Maj. C. J. Allen. Report, **82**, 1833.

Assistants:
J. P. Frizell. Reports, **82**, 1835; **84**, 1634.
R. Davenport. Report, **84**, 1635.

**Physical characteristics.**
Drainage area and reservoir capacity, **82**, 1834; **84**, 1635.

**Surveys.**
In progress, **66**, iii, 36; **67**, 262.
Ordered by act of March 3, 1881, made under direction of Maj. Allen, **82**, 1833.

## CANOOCHEE RIVER, GA.

**Engineers.**
Chief of Engineers. Reports, **80**, 132; **81**, 179.
Engineer in Charge. Lt. Col. Q. A. Gillmore. Report, **81**, 1157.

**Physical characteristics.**
Described, **81**, 1157.

**Plans.**
By Lt. Col. Gillmore, 1880, for removing snags and leaning trees, partly removing rock bars, and forming cut-offs. Estimate, $46,094.41. If improvement be confined to lower 38 miles of river, estimate, $9,405, **81**, 1158.

**Survey.**
Ordered by act of June 14, 1880, **80**, 132; examination made under direction of Lt. Col. Gilmore, **81**, 1157.

## CANYON FERRY. (See *Missouri River.*)

## CAPE ANN, MASS. (See *Sandy Bay.*)

## CAPE CANAVERAL, FLA.

**Commerce.**
No deep-water harbor on the southern coast south of Port Royal, N. C.; harbor at Cape Canaveral would be of great advantage to the phosphate interests of the locality, to the Navy, and to the merchant marine, **93**, 1681; **95**, 1609.

**Engineers.**
Chief of Engineers. Reports, **93**, 211; **95**, 222.

Engineers in Charge:
Lt. A. M. D'Armit, 1893. Report, **93**, 1681.
Maj. T. H. Handbury, 1895. Report, **95**, 1604.

**Physical characteristics.**
Detailed description of (see *Commerce*), **93**, 1682; **95**, 1605.
Currents and tides, **95**, 1605, 1606.

**Projects.**
Maj. Handbury, 1895, estimated that it would cost $7,460,970 to construct a breakwater 2½ miles long, and $4,091,010 for works to protect a small area to accommodate 25 first-class vessels and 500 small coasting vessels, **95**, 1604.

**Surveys.**
Examination for a harbor at Cape Canaveral ordered by act of July 13, 1892, made by Maj. Mallery, 1892 (report favorable), **93**, 1681.
Survey of the same locality ordered by act of August 17, 1894, made, 1895, by Maj. Handbury (see *Projects*), **95**, 1604.

## CAPE CHARLES. (See *Franklin City, Va.*)

## CAPE CHARLES CITY HARBOR, VA.

**Appropriations.**
1890, $25,000, **91**, 1200.
1892, 10,000, **92**, 979.
1899, 20,000, **99**, 1478.

Total, 55,000

**Contracts.**
**1890.** American Dredging Co., dredging, 18 cents per c. y., **91**, 1199.
**1896.** Sandford & Brooks, dredging, 13.9 cents per c. y., p. m., ($3,000) **97**, 1372. J. Keller & Son, mattresses, $1.40

## CAPE CHARLES CITY HARBOR, VA.—Continued.

per c. y., and stone, $2.55 per c. y., ($7,355.85) **97,** 1372.

**1899.** C. W. Johnston, jetty construction: brush mattress, $1.49 per c. y., stone, $2.50 per short ton, brush in place of mattress for shore end of south jetty, $1.25 per c. y. ($39,246.50), **1900,** 1770.

### Engineers.

Chief of Engineers. Reports, **89,** 112; **90,** 102; **91,** 130; **92,** 130; **93,** 142; **94,** 131; **95,** 149; **96,** 136; **97,** 194; **98,** 197; **99,** 227; **1900,** 259.

Engineers in Charge:

Maj. W. F. Smith, U. S. agent, 1888–96. Reports, **90,** 971, 973; **91,** 1199; **92,** 979; **93,** 1227; **94,** 904; **95,** 1145; **96,** 971.

Capt. T. L. Casey, 1897–99. Reports, **97,** 1370; **98,** 1229; (Maj.) **99,** 1478.

Maj. J. B. Quinn, 1900–. Report, **1900,** 1768.

Assistant. A. Stierle. Report, **90,** 972.

### Operations.

**1890–91.** 107,079 c. y. dredged from the harbor proper, harbor entrance, and Cherrystone Inlet, **91,** 1200.

**1898–99.** 14,457 c.y., p.m., dredged, and 723 c. y. brush mattress and 2,648 c. y. stone deposited to make 400 f. of jetty at Cherrystone Inlet, **97,** 1371.

**1899–1900.** 3,141 tons stone placed in north jetty and 200 c. y. brush and 195 tons stone placed on south jetty, **1900,** 1769.

### Physical characteristics.

Description of, **90,** 976; **91,** 1199.

### Private (corporate) work.

In 1896–97 the Philadelphia and Norfolk R. R. constructed 750 f. of the jetty at Cherrystone Inlet in addition to what the Government built, **97,** 1371.

### Projects.

By Maj. Smith, 1890, dredging the harbor and the entrance thereto to a depth of 14 f. below mean low tide; also dredging the present channel in Cherrystone Inlet and across Cherrystone Bar to a width of 100 and 200 f., respectively, and a depth of 16 f. at mean low tide, with construction of stone contractive works at the harbor entrance; estimate, $142,340, **90,** 979; **91,** 1199.

Act of July 13, 1892, provided that no money should be expended for the improvement of this harbor until its owners should in a manner satisfactory to the Secretary of War grant vessels free entry except for the payment of reasonable wharf charges, and should provide an approach to the wharves not less than 40 f. wide from the nearest public highway, **93,** 1227; this proviso was repealed by act of June 3, 1896, **96,** 971.

By Maj. Casey, 1899, for expenditure of available funds to complete north jetty and commencement of the one proposed on the south side of the entrance, **99,** 1478.

### Survey.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Smith, **90,** 975.

## CAPE COD SHIP CANAL, MASS.[a] (See *Buzzards Bay.*)

### Commerce.

History of commerce passing across the isthmus of Cape Cod since 1823, **70,** 478, 479.

Importance of, during the war of 1812, **70,** 478, 479.

Benefit of improvement to commerce, **70,** 417, 481, 485, 486, 487, 492, 495.

Value of facilitating inland coastwise trade, especially during war, **70,** 487, 488, 494.

### Defense.

Military value of canal, **70,** 488.

### Engineers.

Chief of Engineers. Reports, **70,** 476, 491; **97,** 64.

Boards of Engineers.

1825. Board of internal improvement report in favor of a canal route via Buzzards and Barnstable bays, **70,** 480. Report, **70,** 491. (Gen. Bernard, Maj. Totten, and J. L. Sullivan.)

1860. Advice of board to committee appointed by the State legislature to investigate the proposed location and construction of canal, **70,** 481.

Engineers in Charge:

Lt. Col. J. G. Foster, 1870, **70,** 477. Reports, **70,** 477, 489.

Lt. Col. S. M. Mansfield, 1897. Report, **97,** 864.

### Estimates. (See *Plans.*)

By Lt. Col. Foster, breakwater to protect the canal, $1,923,400, **70,** 477. For ship canal, $9,703,525, **70,** 490.

Early estimates for canal, **70,** 494.

### Legislation.

Resolution of the legislature of Massachusetts in favor of granting aid to the

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[a] Cape Cod Canal, from Hyannis to Barnstable Bay, Mass. Examination.—Report (unfavorable), Feb. 3, 1825. (H. Doc. No. 482, 55th Cong., 2d sess.)

Cape Cod and Cape Cod Harbor, Mass. Survey.—Report, Dec. 21, 1835. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CAPE COD SHIP CANAL, MASS.—Continued.

Cape Cod ship canal by the construction of a breakwater at the eastern end of the canal, **70**, 477.

Charter granted by the State of Massachusetts for the construction of a canal, **70**, 477.

1791. Committee appointed by the State legislature to investigate practicability and cost of a navigable channel across the isthmus, **70**, 479.

Subsequent legislation, **70**, 478, 479, 481, 490.

**Physical characteristics.**

Tidal record, **70**, 482, 483, 492, 494.

Maximum velocity in canal that would be caused by tide, **70**, 483, 484.

Temperature of water and climate, **70**, 484, 494.

Sand at Barnstable Bay, **70**, 495.

Description of Cape Cod Harbor, **70**, 495.

**Plans.** (See *Estimates.*)

History of early plans, **70**, 478, 479.

By G. R. Baldwin, canal to begin at Black River Harbor, to be 7.6 miles long, 120 f. wide at bottom, 204 f. at water line, and 18 f. deep, to be fed from Barnstable Bay. Locks and receiving basins at each end, and a breakwater at Barnstable Bay side, **70**, 481.

By Lt. Col. Foster, breakwater to form an artificial harbor and protection to canal, **70**, 488, 489. General conclusions of Lt. Col. Foster, strongly advocating an open canal, **70**, 483–489.

**Surveys.**

By Mr. Machin, to determine the practicability of a canal, 1776, **70**, 479.

By John Hills, 1791, **70**, 479.

By L. Baldwin, 1818, **70**, 479, 492.

By Maj. Perault, 1825, **70**, 480.

By State of Massachusetts, 1860, **70**, 481.

Examination of approaches ordered by act of June 3, 1896, made by Lt. Col. Mansfield in 1897 (no canal), **97**, 864.

## CAPE ELIZABETH. (See *Richmond Island Harbor, Me.*)

## CAPE FEAR AND DEEP RIVERS, N. C. (Reeves Point to La Grange.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 76; **72**, 73, 74.

ENGINEER IN CHARGE. Maj. W. P. Craighill, 1871–72. Reports, **71**, 621; **72**, 741.

ASSISTANT. G H. Elliott. Report, **72**, 742.

**Plans.**

First division, La Grange to Fayetteville, 85 miles. Improvement of falls that occur at intervals throughout its extent by the construction of 19 river dams and 2 slough dams, varying from 7½ f. to 17 f. in height, of rubble masonry, and 23 locks of masonry, with gravel banks when needed; 5 f. depth of water on miter sills, lock chambers 120 f. by 20 f.

Second division, Fayetteville to Hungry Neck, 66 miles. Sixty miles of longitudinal dikes, and 15,000 c. y. dredging.

Third division, Hungry Neck to Wilmington, 46 miles, no improvement.

Fourth division, Wilmington to Reeves Point, 19 miles. Removing wreck, *North Heath;* removing timber obstructions; removing shoal called "The Logs;" dredging 135,000 c. y.

Estimated cost, $2,316,711, **72**, 742–749.

**Private (corporate) work.**

Companies organized for improving Cape Fear, Deep, and Haw rivers in 1796 and 1849, received liberal aid from the State, and spent much money (the latter company $350,000) to construct dams, canals, and locks. Work practically an utter failure. **72**, 744.

**Survey.**

Under direction of Maj. Craighill, by G. H. Elliott, 1871; reports, **71**, 621; (report unfavorable—"too expensive") **72**, 741–749.

## CAPE FEAR RIVER, N. C. (See *Norfolk Harbor, Northeast River, N. C.*)[a]

**Appropriations.**

| | | | |
|---|---|---|---|
| 1829, | $20,000.00, act Mar. 2. | 1834, | $5,234.00, act June 8. |
| 1830, | 25,688.00, act Apr. 23. | 1835, | 20,000.00, act Mar. 3. |
| 1831, | 25,705.00, act Mar. 2. | 1836, | 20,000.00, act July 2. |
| 1832, | 28,000.00, act July 3. | 1837, | 10,000.00, act Mar. 3. |
| 1833, | 28,000.00, act Mar. 2. | 1838, | 20,000.00, act July 7. |

[a] Surveys below Wilmington—Report, Dec. 10, 1827; estimate, $39,818.80. Report, July 11, 1829; estimate, $154,588.12. Report, Mar. 30, 1853; estimate, $958,200. Report, Mar. 18, 1858; estimate, $443,400. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CAPE FEAR RIVER, N. C.—Continued.

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1847, | $601.92, | act Mar. 2. |
| 1852, | 20,000.00, | act Aug. 30. |
| 1854, | 140,000.00, | act July 2. |
| 1870, | 100,000.00, | **70**, 70, 421. |
| 1871, | 75,000.00, | **71**, 75, 610. |
| 1872, | 100,000.00, | **72**, 71, 699. |
| 1873, | 100,000.00, | **73**, 77. |
| 1874, | 150,000.00, | **74**, 89, ii, **71**. |
| 1875, | 150,000.00, | **75**, 90, ii, 99. |
| 1876, | 132,500.00, | **76**, 66, 309; **77**, 63, 333. |
| 1878, | 160,000.00, | **78**, 69, 476. |
| 1879, | 100,000.00, | **79**, 81, 557. |
| 1880, | 70,000.00, | **80**, 697. |
| 1881, | 140,000.00, | **81**, 919. |
| 1882, | 225,000.00, | **82**, 934. |
| 1884, | 200,000.00, | **84**, 938. |
| 1886, | 157,500.00, | **86**, 1004. |
| 1888, | 245,000.00, | **88**, 900. |
| 1890, | 170,000.00, | **90**, 1156. |
| 1892, | 200,000.00, | **92**, 1169. |
| 1894, | 200,000.00, | **95**, 1340. |
| 1896, | 195,000.00, | **96**, 1133. |
| 1899, | 150,000.00, | **99**, 1508. |
| Total, | 3,383,228.92 | |

**Commerce.**

**80**, 712; **84**, 947; **86**, 1059.

Advantages resulting from improvement, **82**, 946.

Large and important trade in cotton, lumber, etc., **93**, 1423; **94**, 1052; **95**, 1340.

Description of, **1900**, 1822.

**Contracts.**

**1874.** Curtis, Fobes & Co., dredging, 14, 15, and 16 cents per c. y., **75**, ii, 102; **76**, 308.

**1875.** Curtis, Fobes & Co., dredging, 17¾ cents per c. y., **75**, ii, 102; **76**, 308. Bangs & Dolby, material and labor, **76**, 308, 314.

**1876.** Bangs & Dolby, stone, $1.89 per c. y., **77**, 332, 335.

**1877.** W. H. French, stone, $1.63⅝ per c. y., **78**, 476.

**1878.** French & Dolby, stone, $1.75 per c. y., **79**, 557.

**1879.** Ross & Pennypacker, stone, $2.24 and $2.29 per ton, **80**, 697; completed, **80**, 699.

**1881.** G. H. Ferris, dredging, 14⅜ per c. y., **81**, 921; completed, **83**, 719.

**1883.** National Dredging Co., dredging, 16.7 cents per c. y.; annulled, **83**, 719. New York Steam Dredging Co., dredging, 17¾ cents per c. y., **83**, 718; completed, **83**, 720. New York Steam Dredging Co., dredging, 14⅝ cents per c. y., **84**, 938. Ross & Lara, brush and cane, $36.0 and $2.60 per cord, respectively, **84**, 938; completed, **84**, 942. J. C. Springer, ratline and spun yarn, 10⅝ and 9½ cents per pound, respectively, **84**, 938; completed, **84**, 942. G. M. Summerell, scows, $1,150, $600, $580, $566, and $550, respectively, **84**, 938; completed, **84**, 941. Ross & Lara, stone, $1.35 per ton, **84**, 939; completed, **85**, 1087.

**1884.** Ross & Lara, stone, $1.48 per ton, **86**, 1012; completed, **85**, 1088. G. J. French, stone, $1.55 and $1.48 per ton; extended, **85**, 1088; completed, **86**, 1012. J. C. Froehlich & Co., steam boiler, $1,240; completed, **85**, 1088. R. Moore, dredging, 14½ cents per c. y., **85**, 1089; extended, **85**, 1089; completed, **85**, 1093.

**1886.** A. Martin, jetty stone, $1.52 per ton, **87**, 1052.

**1887.** Atlas Dredging Co., dredging, 9 cents per c. y., **87**, 1052.

**1888.** T. Smith, steam boiler, $3,045, **88**, 900.

**1889.** Atlas Dredging Co., dredging, 12 cents per c. y., **89**, 1092.

**1890.** P. S. Ross, dredging, 13¼ cents per c. y., **91**, 1398.

**1892.** C. P. E. Burgwyn, dredging, 12.49 and 12.44 cents per c. y., s. m., $125,000, **93**, 1424. This contract was curtailed by supplemental agreement in 1894 to provide funds for purchase of a new Government dredge, **94**, 1048.

**1894.** Charles Hillman Ship and Engine Building Co., dredging steamer, $55,000, **95**, 1342.

**1895.** Fowler & Morrison, coal, $2.60 per long ton, **95**, 1342.

**1896.** Cordes & Bochman, dredging plant, $27,550, **97**, 1407.

**1898.** J. A. Springer & Co., 750 tons coal, $2.85 and $2.95; Davis Coal and Coke Co., 500 tons coal, $2.59 per ton, **98**, 1256. Theo. Smith & Bro., iron gear-wheel friction for dredge, $3,830, **98**, 1256.

**1899.** The Columbian Iron Works and Dry Dock Co., tugboat, $26,500, **1900**, 1823.

**Documents.** (Not printed in reports.)

Numerous documents referred to by Lt. Col. Foster, **73**, 804–815.

Report of Capt. Hartman Bache, H. Doc. 120, 20th Cong., 1st sess.

Report of commission of 1853, H. Doc. 1, 33d Cong., 1st sess., part 2, **73**, 807, 814.

Report of commission of 1858, Ex. Doc. 2, 36th Cong., 1st sess., part 3, page 829, **73**, 809.

Report, Col. J. H. Simpson, S. Doc. 27, 41st Cong., 3d sess., **71**, 610.

All reports of engineers in charge prior to 1870.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 3. Reports, **70**, 32, 70; **71**, 74; **72**, 70; **73**,

## CAPE FEAR RIVER, N. C.—Continued.

77; **74**, 88; **75**, 90; **76**, 65; **77**, 62; **78**, 68; **79**, 80; **80**, 125, 109; **81**, 148; **82**, 143, 941; **83**, 147; **84**, 150; **85**, 171; **86**, 168; **87**, 132; **88**, 125; **89**, 144, 148; **90**, 130; **91**, 166; **92**, 165; **93**, 179; **94**, 164; **95**, 187; **96**, 169; **97**, 209; **98**, 210; **99**, 242; **1900**, 274.

BOARDS OF ENGINEERS.

Commission convened Mar. 30, 1853, and reported in favor of the improvement at and below Wilmington by jetties, fences, revetments, etc., **73**, 807; **76**, 323. Report, H. Doc., 33d Cong., 1st sess. (Prof. A. D. Bache, U. S. C. S.; Maj. I. I. Stevens, U. S. E.; Capt. D. P. Woodbury, U. S. E., and Lt. C. H. Davis, U. S. N.)

Board of river and harbor improvements, to which was referred the report of the aforesaid commission, reported thereon Apr. 18, 1853, approving part of the plan, but substituting a plan of improvement by dredging, wing dams, jetties, etc., **73**, 809. (Col. De Russy and others.)

Commission convened Dec. 30, 1858, to examine condition of entrances of Cape Fear River. Recommended improvement by construction of stone jetties, **73**, 810, 811. Report, Ex. Doc. 2, 36th Cong., 1st sess. (Prof. A. D. Bache, U. S. C. S.; Hon. I. I. Stevens, M. C.; Lt. J. N. Moffit, U. S. N.; Capts. A. A. Humphreys and W. B. Franklin, and Lt. W. H. C. Whiting.)

Board convened at Wilmington, Dec. 12, 1871, and Jan. 12, 1872. Recommended continuation of the work, **73**, 797–799. (Lt. Cols. Tower, Wright, and Foster, and Majs. Gillmore and Craighill.)

Reconvened at New York City, Dec. 6, 1872. Recommended dredging at Baldhead Channel, that the work of closing be continued to Zekes Island, and closing New York Inlet with pile work. Report, **73**, 799–815. (Lt. Cols. Tower, Wright, and Foster, and Majs. Gillmore and Craighill.)

Constituted by S. O., No. 129, C. of E., 1881, **82**, 942. (See *Projects.*) (Lt. Cols. Gillmore, Craighill, and Comstock, and Capt. Turtle.)

ENGINEERS IN CHARGE:

Lts. J. K. Mansfield and John Winder, in 1835. Inspection, **73**, 814.

Lt. A. J. Swift, 1836–1838, **73**, 814.

Capt. McClellan, 1839, **73**, 814.

Capt. D. P. Woodbury, 1853–1855, **70**, 422; **73**, 804, 809, 810.

Lt. Whiting, 1856, **73**, 810.

Col. Turnbull, 1857, **73**, 810.

Col. J. H. Simpson, 1870, **70**, 421.

Maj. W. P. Craighill, 1870. **71**, 74–77. Reports, **71**, 609; **72**, 698; **73**, 789; **74**, ii, 68; **75**, ii, 98; **76**, 308; **77**, 332.

Capt. C. B. Phillips, 1878, in temporary charge. Reports, **78**, 475, 492.

Lt. Col. W. P. Craighill, 1878–85. Reports, **79**, 556; **80**, 695; **81**, 918, 919, 920; **82**, 934; **83**, 717; **84**, 937.

Capt. W. H. Bixby, 1885–92. Reports, **85**, 1087; **86**, 1000; **87**, 1047; **88**, 895; **89**, 1089, 1132; **90**, 1152; **91**, 1394.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1164; **93**, 1419; **94**, 1047; **95**, 1335.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1131.

Capt. W. E. Craighill, 1897–98. Reports, **97**, 1406; **98**, 1255.

Capt. E. W. Van C. Lucas, 1899–. Reports, **99**, 1507; **1900**, 1818.

ASSISTANTS:

Lt. W. R. Livermore, **70**, 422.

W. Griswold, **70**, 422; **71**, 610.

Capt. C. B. Phillips, **76**, 309. Reports, **74**, ii, 69, 71; **75**, ii, 99. Historical sketch of work, **76**, 321–331.

H. Bacon. Reports, **76**, 314; **77**, 335; **78**, 477, 493; **79**, 557; **80**, 698; **81**, 922; **82**, 937; **83**, 718; **84**, 939; **85**, 1091; **86**, 1011; **87**, 1053; **88**, 902; **89**, 1093; **90**, 1156.

R. C. Merritt. Report, **91**, 1398.

E. D. Thompson. Reports, **92**, 1169; **93**, 1424.

C. Humphreys. Reports, **88**, 901; **94**, 1053; **95**, 1341; **96**, 1133; **97**, 1410; **98**, 1259; **99**, 1511.

**Estimates.** (See *Projects.*)

By Col. Simpson, breakwater connecting Zekes and Smiths islands, $256,415.53, **70**, 70.

By Maj. Craighill, increased, **71**, 610.

By Capt. Phillips, dredging a 12-f. channel to Wilmington, $260,000, **74**, ii, 69, 70. Afterwards reduced to $120,000, **75**, ii, 101.

By Maj. Craighill, work at Smiths Island and extension of Federal Point jetty, etc., $90,000, **74**, ii, 70.

By Maj. Craighill and Capt. Phillips, completing the work of closing New Inlet, $420,000, **75**, ii, 99.

By Maj. Craighill, completing existing project, $50,000, **79**, 557; increased to $75,500 on account of damage by storm, **79**, 81.

By H. Bacon, to complete existing project, $199,375; and $15,000 for annual dredging, **79**, 561.

**Expenditures.**

Total to Oct. 11, 1856, at Baldhead and Zekes Island, $138,750, **73**, 810.

**Operations.**[a]

**1829–38.** Jetties built by United States, **73**, 813.

**1853.** Work begun at mouth of river, **73**, 809.

**1870–71.** Closing inlets by crib work, **70**, 70, 422; 607 f. breakwater and superstructure built, **71**, 75, 610.

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[a] History of operations from 1761 to 1886, **86**, 1004. History of past operations, **86**, 943, 1006, 1008. History of operations to 1872, by Lt. Col. Foster, **73**, 805–815. By Capt. Phillips, to 1876, **76**, 321–331.

## CAPE FEAR RIVER, N. C.—Continued.

**1871-72.** Breakwater extended nearly 1,200 f., **72,** 70.

**1872-73.** Extension of breakwater to 4,403 f., and protection to Smiths Island beach, **73,** 789, 790.

**1873-74.** The deflecting jetty from Federal Point extended to 500 f. in length; dredging at Baldhead Bar, and at the "Logs," **74,** 88, 89, ii, 71, 72.

**1874-75.** Dredging at Baldhead Bar, removing stumps at the "Logs," dredging at Horseshoe Shoals, and repairs to Federal Point jetties, and the works between Smiths and Zekes islands, **75,** 90, ii, 99.

**1875-76.** An apron of timber, brush, and stone, from Federal Point jetty to Zekes Island (initial to closing New Inlet), a distance of 4,352 f.; dredging at Horseshoe Shoals continued, cut increased from 100 f. to 200 f. in width, and from 9 f. to 12 f. in depth; dredging at Baldhead Channel, removal of obstructions placed by Confederates in the river channel, **76,** 65, 308, 309, 314, 315.

**1876-77.** 20,304 c. y. stone placed by contract between Zekes Island and Federal Point to continue work of closing the inlet, **77,** 62, 333, 335. Repairs to the works between Smiths and Zekes islands, **77,** 336.

**1877-78.** 40,440 c. y. stone deposited on the dike closing New Inlet, **78,** 68, 475, 477, 492.

**1878-79.** Placing stone on New Inlet dike and dredging on Baldhead Bar, **79,** 80, 556, 558, 560.

**1879-80.** 28,398 c.y. riprap placed in dam and 70,245 c. y. sand removed by suction dredge from Baldhead Channel, **80,** 696; two lighters and scow constructed, **80,** 698; repairs to pumping apparatus, **80,** 701.

**1880-81.** 5,427 tons contract stone for coping, 2,367 tons rough, heavy stone, and 12,880 c. y. riprap delivered in dam, **81,** 923; 218 tons stone ballast placed in dam, **81,** 922; 62,044 c. y. dredged in Baldhead Channel; 81,924 small trees transplanted at Federal Point, Zekes and Smiths islands, **81,** 925.

**1881-82.** 303,535 c. y. material dredged from Snows Marsh Channel, **82,** 937; 21,967 c. y. material dredged from Baldhead Channel, **82,** 939; flanks of dam strengthened with 238 c. y. stone riprap, **82,** 938. Unsuccessful attempt to close northerly swash by pile work, **82,** 938.

**1882-83.** 986,661 c. y. material dredged from Snows Marsh Channel, **83,** 719; repair of steam tug, **83,** 721.

**1883-84.** 333,129 c. y. material dredged from Snows Marsh Channel and Midnight Shoal, **84,** 940; 4,605 cords brush, 191 cords cane, and 11,861 tons stone delivered on dam, **84,** 941; 1,338 tons stone ballast purchased and 417 cords brush, **84,** 194; wharf built, **84,** 194; 53,350 s. y. mattress laid, at an average cost of 66.2 cents per s. y., **84,** 942; repairs to suction dredge Woodbury, **84,** 943.

**1884-85.** 39,235 tons stone delivered, **85,** 1091; two scows built by hired labor, **85,** 1088; 321,925 c. y. material dredged, **85,** 1089.

**1885-86.** 325,449 c. y. material dredged, **86,** 1012; removal of stumps by dynamite, **86,** 1012.

**1886-87.** 332,112 c. y. dredged from the shoals; 11,630 tons stone placed in dike; 10,125 c. y. dredged from bar; surveys of river shoals, **87,** 1049, 1053.

**1887-88.** 282,068 c. y. material dredged; 14,551 tons stone placed upon the dike, **88,** 893.

**1888-89.** 243,826 c. y. material dredged; top and slopes of new dam for 2,468 f. faced with stone, **89,** 1093.

**1889-90.** 1,237,936 c. y. material dredged from channel and shoals, **90,** 1155.

**1890-91.** 356,224 c. y. material dredged, **91,** 1397.

**1891-92.** 105,503 c. y. material dredged, **92,** 1171.

**1892-93.** 148,398 c. y., s. m., dredged under contract, and 101,991 c. y. dredged by Government plant. A small number of obstructions removed. **93,** 1425, 1426.

**1893-94.** 537,681 c. y., s. m., dredged by contract, and 47,608 c. y. dredged by Government dredge, **94,** 1048. Design and specification for dredging steamer prepared, **94,** 1051. Gauges on the river connected by a line of levels from Wilmington to Burbank Point, **94,** 1051.

**1894-95.** 475,829 c. y., s. m., dredged under contract, and 32,839 c. y. dredged by Government dredge. A training dike 5,692 l. f. long was built. A wharf 125 by 45 f. was built at old Fort Johnson. Repairs were made to banks. **95,** 1339. A suction dredge steamer built, **95,** 1337.

**1895-96.** 473,886 c. y. dredged by Government dredge. Snows Marsh dike was extended 2,992 f. upstream and 556 f. downstream; 1,788 piles being driven and 1,533 cords brush fascines being used. Minor repairs were made to Swash Defense Dam and New Inlet Dam; about 200 tons of stone and 1,822 bags of sand, etc., being used. **96,** 1132.

**1896-97.** Repairs to New Inlet Dam were completed. Training dike at Snows Marsh extended 228 f. at the upper end and 496 f. at the lower end, and 2,470 l.

## CAPE FEAR RIVER, N. C.—Continued.

f. of this dike were repaired; 550,524 c. y. dredged by Government dredge, 25 stumps and 1 log removed, **97**, 1406.

**1897–98.** 851,181 c. y. dredged by Government dredge, 100 stumps and 4 logs removed, **98**, 1255.

**1898–99.** 348,161 c. y. dredged, **99**, 1512.

**1899–1900.** 1,085,528 c. y. dredged, 329 logs and 256 stumps removed, **1900**, 1818, 1819.

**Physical characteristics.**

Described, **72**, 698, 699; **73**, 789, 790, 805–815; **74**, ii, 68–72.

Tidal observations, with diagram, **76**, 318–321; **77**, 339; tidal observations, **80**, 699; **81**, 925, 927; **82**, 940; **83**, 723; **84**, 945; **85**, 1096.

See also historical sketch, **76**, 321–331.

Table of prevailing direction of wind at Smithville and Federal Point, **80**, 703.

Table showing greatest differences of the water level between the river and sea sides of the dam at the New Inlet during flood and ebb tides, **80**, 710.

Effect of storms, **82**, 944.

Advance of shore lines of Federal Point and Zekes Island; extension of beach, **83**, 720; **84**, 940.

Condition of shore line 1886, **86**, 1014.

Geographical description of river, **86**, 1000.

Changes, 1852 to 1885, **85**, 1090.

Description of, Wilmington to mouth, **89**, 1132.

Description of, vicinity of outer bar, **94**, 1049; **95**, 1339.

Current observations, **94**, 1051, **95**, 1337.

**Private (State) work.**

The improvement of the river between Campbells Island and Wilmington by embankments, jetties, and dredging, commenced by the State government in 1823 and continued to 1829, under the direction of State Engineer Hamilton Fulton, **73**, 813; **76**, 323, 326.

Appropriations made by State of North Carolina, 1822 to 1829, **86**, 1007.

Works carried on under the State, **82**, 943; **86**, 1008.

**Projects.** (See *Estimates.*)

History and description of, from the commencement to 1872, by Lt. Col. Foster, **73**, 805, 815. By Capt. Phillips, commencement to 1876, **76**, 321–331. For the original projects, see *Private Work.*

By Capt. Hartman Bache, in 1827. Modifies plans of Mr. Fulton and proposes sheet-pile jetties at Eagle Island, the Northwest Branch, and six other places below Wilmington, **73**, 813, 814.

By commission and board of river and harbor improvements, in 1853, for protection of Baldhead Point by jetties, closing of openings through the beach at Smiths Island, and a jetty at north end of Zekes Island, **76**, 323.

By board of commissioners, in 1858, for restoration of the old works and jetties at Zekes Island, protection of Smiths Island beach by jetties, and provisional closing of New Inlet, **76**, 324.

By Board of Engineers, in 1871–72, for dredging in Baldhead Channel, continuation of work at Zekes Island on present plan, continuing it across the island and into the river, and closing New Inlet by pile work filled with brush and loaded with stone; suspension of work on jetty and beach protection at Baldhead Point, **73**, 802.

History of past projects and operations, **82**, 943; **86**, 168, 1006; **87**, 1047.

The Board of Engineers, 1881, in preliminary report, recommend that existing works between Zekes and Smiths islands be strengthened, and that upon a threatened break in the low beach south of Smiths Island a mattress and riprap sill be placed to prevent such break, **82**, 947. (Lt. Cols. Gillmore, Craighill, and Comstock, and Capt. Turtle.)

The projects of 1872 to 1882 proposed the extension of New Inlet Dam 2 miles downstream to prevent further erosion of Smith's Island. The project of 1875 proposed occasional dredging in the outer bar; and the projects of 1874 to 1881, for the improvement of the 20 miles above New Inlet, proposed dredging wherever necessary to secure a channel eventually 16 f. deep at m. l. w. and 270 f. wide. Amounts appropriated from 1829 to 1886, $2,223,228.92. Estimated to complete project in 1886, $245,000, **82**, 947; **86**, 168, 1006. Increased in 1887 to $265,000, **87**, 1048, 1051, 1058.

The projects of 1874 to 1881, for the 20 miles above New Inlet, as outlined to 1888, proposed dredging, with occasional diking when necessary, across the shoals, so as to secure, first, a 12-f. channel 200 f. wide, and afterwards a 16-f. channel 270 f. wide at low water, over this entire length. The total final cost of this work under the projects of 1870 to 1885 was estimated, in 1886, at $2,110,000. On account of inadequate yearly appropriations these estimates were raised in 1888 to $2,125,000.

By Capt. Bixby, 1889, obtaining a 20-f. low-water depth, 270 f. wide, Wilmington to the mouth, 18 to 20 f. on the bar, by dredging and the construction, if necessary, of a stone jetty to prevent swinging and shoaling of the channel; estimate, $1,800,000, with annual cost for maintenance of from $18,000 to $25,000 annually, **89**, 1134; **93**, 1419.

By Maj. Stanton, 1894, training dike

## CAPE FEAR RIVER, N. C.—Continued.

of piles, brush, and stone to be built in connection with dredging at Snows Marsh Shoal, **94**, 1051.

Lt. Col. Heap, 1894, estimated that $25,000 would be required annually for maintenance, **96**, 1132.

**Surveys.**

Summary and history of, from 1733 to 1872, by Lt. Col. Foster, **73**, 804–815, and by Capt. Phillips to 1876, **76**, 321–331.

Under direction of Maj. Craighill by Henry Bacon, at various places, **77**, 337; **79**, 475, 479.

Snows Marsh to Wilmington, **82**, 937.

Prices Creek to Wilmington, **82**, 932; **83**, 721.

Baldhead Channel, **84**, 943.

Baldhead Channel, **85**, 1095.

Beaches in vicinity, **85**, 1096.

Entrance to Reeves Point, **86**, 1013.

Examination for a 20-f. channel from Wilmington to the ocean ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Bixby, **89**, 1132.

Examinations and surveys of all dredged places made, 1892–93, under the direction of Maj. Stanton, **93**, 1426, 1427.

Survey of the bar and shore lines at the river mouth made, 1893–94, under the direction of Maj. Stanton, **94**, 1051.

Surveys were in progress, 1894–95, under the direction of Maj. Stanton, **95**, 1336, 1340.

Survey of the river for the establishment of harbor lines for the city of Wilmington, hydrographic surveys of the ocean bar and Snows Marsh Channel, made under the direction of Lt. Col. Heap, 1895–96, **96**, 1132.

Survey made by Capt. Craighill, 1898, and by Capt. Lucas, 1899, **99**, 1507.

Survey made, 1900, by Capt. Lucas, **1900**, 1821.

Maps:

History and list of, from 1733 to 1872, **73**, 804–815. Sketch of obstructions placed in the river by Confederates, **76**, 330.

Showing channels near New Inlet and the proposed new cut, **78**, 476.

Sketches of the dam, **78**, 478.

**81**, 922; **83**, 722; **84**, 940; **85**, 1090, 1094; **86**, 1002, 1016; **87**, 1050.

Cape Fear River below Wilmington, **88**, 900; **89**, 1092; **90**, 1156; **91**, 1938; **93**, 1428; **94**, 1052; **95**, 1344; **96**, 1138; **97**, 1416; **99**, 1514; **1900**, 1822.

## CAPE FEAR RIVER, N. C. (above Fayetteville).

**Commerce.**

Description of, **96**, 1146.

**Engineers.**

Chief of Engineers. Report, **84**, 177; **96**, 171; **1900**, 277.

Engineers in Charge:

Maj. W. P. Craighill. Report, **72**, 741, 749.

Capt. J. Mercur. Report, **84**, 1064.

Maj. W. S. Stanton, 1894–96. Report, **96**, 1144.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1144.

**Physical characteristics.**

Description of, **72**, 742; **96**, 1145.

The river is formed by the confluence of the Deep and Haw rivers at Haywood, N. C., **96**, 1145.

**Projects.**

Maj. Stanton in 1895 estimated that improvement of the river by means of locks and dams would cost from $2,555,000 to $3,000,000, **96**, 1146.

**Surveys.**

Ordered by act of Mar. 3, 1871, made under the direction of Maj. Craighill, **72**, 742.

Examination ordered by act of Aug. 2, 1882, made under the direction of Capt. Mercur, **84**, 1064. (Reports unfavorable.)

Survey ordered by act of Aug. 17, 1894, made by Maj. Stanton in 1895 (see *Projects*), **96**, 1144.

## CAPE FEAR RIVER, N. C. (above Wilmington.)

**Appropriations.**

1881, $30,000, **81**, 1081.
1882, 30,000, **82**, 1099.
1884, 5,000, **84**, 1043.
1886, 11,250, **86**, 998.
1888, 12,000, **88**, 895.
1890, 15,000, **90**, 1150.
1892, 15,000, **92**, 1161.
1894, 14,000, **95**, 1334.
1896, 5,000, **96**, 1130.
1899, 5,000, **99**, 1505.

Total, 142, 250

**Commerce.**

Decrease in freight and insurance rates, **89**, 1088.

A railroad parallels the river and takes much of the freight that formerly went by water, but the maintenance of a channel in the river helps to control freight rates by the railroad, **93**, 1413; **94**, 1045; **95**, 1334.

Description of, **1900**, 1816.

**Engineers.**

Chief of Engineers. Reports, **81**, 168; **82**, 160; **83**, 167; **84**, 172; **85**, 170;

**CAPE FEAR RIVER, N. C. (above Wilmington)**—Continued.

**86**, 166; **87**, 131; **88**, 124; **89**, 143; **90**, 129; **91**, 165; **92**, 165; **93**, 178; **94**, 164; **95**, 186; **96**, 168; **97**, 208; **98**, 210; **99**, 241; **1900**, 274.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1870–80. Report, **80**, 695.

Capt. C. B. Phillips, 1880–81, **81**, 985.

Capt. J. Mercur, 1881–85. Reports, **81**, 1017, 1018; **82**, 1098; **83**, 858; **84**, 1042.

Capt. W. H. Bixby, 1885–92. Reports, **85**, 1083; **86**, 995; **87**, 1044; **88**, 893; **89**, 1083; **90**, 1148; **91**, 1390.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1158; **93**, 1411; **94**, 1044; **95**, 1333.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1128.

Capt. W. E. Craighill, 1897–98. Reports, **97**, 1404; **98**, 1253.

Capt. E. W. Van C. Lucas, 1899–. Reports, **99**, 1505; **1900**, 1816.

ASSISTANTS:

W. H. James. Reports, **82**, 1099; **83**, 859; **84**, 1043.

C. Humphreys. Reports, **85**, 1084; **86**, 999; **89**, 1086; **90**, 1151; **91**, 1393.

E. D. Thompson. Reports, **92**, 1161; **93**, 1414.

C. Schuster. Reports, **96**, 1128; **97**, 1405.

**Legislation.**

$10,000 paid to Cape Fear Navigation Co. for deed extinguishing right to collect tolls for navigation on river between Wilmington and Fayetteville, **81**, 1017.

**Operations.**

**1881–82.** 811 trees, logs, snags, and stumps removed, clearing 23 miles of river, **82**, 1100.

**1882–83.** 14,287 trees, stumps, logs, and snags removed, **83**, 859.

**1883–84.** 6,712 trees, stumps, logs, and snags removed, **84**, 1043.

**1884–85.** 1,442 l. f. timber jetty and 300 l. f. of rock jetty built; 301 l. f. old log jetties sheeted; 8,644 trees, stumps, and snags removed, **85**, 1085.

**1885–86.** 874 trees, logs, and snags removed; 680 c. y. hard mud and 1,438 c. y. rock and hardpan dredged, **86**, 999.

**1886–87.** Small amount of work done by hired labor, **87**, 1046.

**1887–88.** 127 logs, stumps, and piles removed from river bed; 900 stumps and trees removed from river bank; 2,385 c. y. rock quarried, **88**, 894.

**1888–89.** 2,570 c. y. stone quarried; 80 logs and trees and 50 l. f. of old pile jetty removed from the channel, and trees and brush from the banks, **89**, 1085.

**1889–90.** 1,277 c. y. stone quarried; 184 logs and snags removed from the channel; 620 l. f. jetty (stone and brush) built, **90**, 1149.

**1890–91.** 1,791 c. y. of stone quarried and 1,060 c. y. placed in dikes at McCarters, McRaes, and Thames shoals; 119 trees and 105 cords brush cleared from the banks, and 126 snags and stumps from the channel, **91**, 1391.

**1891–92.** 793 l. f. of brush and stone jetty built at McRaes shoal; 228 snags and trees cleared from the channel, **92**, 1160.

**1892–93.** 33 new jetties of brush and stone, aggregating 3,619 l. f., were constructed, 740 l. f. jetties were raised, and 100 l. f. repaired, **93**, 1412.

**1893–94.** 11 jetties of brush and stone, aggregating 1,277 l. f., constructed, **94**, 1044.

**1894–95.** About 700 logs and other obstructions removed from the channel and banks, 570 l. f. jetties were built, and 2 jetties commenced, **95**, 1334.

**1895–96.** About 600 logs and other obstructions removed from the channel and banks, repairs were made to jetties, and construction of jetties commenced in previous year continued, **96**, 1129, 1130.

**1896–97.** 8 jetties were constructed and obstructions removed from the channel and banks, **97**, 1406.

**1897–98.** About 900 logs and other obstructions removed from the channel and banks, **98**, 1254.

**1898–99.** 290 snags and other obstructions removed from the channel, **99**, 1505.

**1899–1900.** Obstructions removed between Kellys Cove and Fayetteville, **1900**, 1816.

**Physical characteristics.**

Description of, **88**, 893.

Tidal observations, **93**, 1412, 1415; **94**, 1045; **95**, 1333.

List of shoals in the river, **93**, 1416.

Water-gauge record for 1892, **93**, 1418; for 1893 and 1894, and mean of water-gauge readings, **95**, 1334.

**Projects.**

By Capt. Phillips, 1881, clearing snags, trees, etc., 75 miles of river; dredging channel at Thames Shoal, 1,900 f. long, 60 f. wide, and 5 f. deep at low water, and construction of 5,000 l. f. of experimental dike; estimate, $55,775, **81**, 1018. Modified, 1885, by Capt. Bixby, to secure a 4-f. channel, Wilmington to Elizabethtown; thence a similar 3-f. channel to Fayetteville, at an increased cost of $200,000, **85**, 1084. Modified, 1886, by Capt. Bixby, removal of snags, logs, and stumps, and construction of 84,000 l. f.

### CAPE FEAR RIVER, N. C. (above Wilmington)—Continued.

rock jetty, at a cost of $480,000, inclusive of $65,000 previously appropriated, **86**, 996; **87**, 1045; **91**, 1392.

Lt. Col. Heap in 1896 estimated that the cost of maintenance would be $3,000 annually, **96**, 1128.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction of Capt. Phillips, **80**, 1018.

Surveys made of 16 shoals, **85**, 1083.

All the shoals were surveyed in 1893 under direction of Maj. Stanton, **93**, 1412.

Maps. **85**, 1086; **89**, 1086; **90**, 1150; **91**, 1392; **93**, 1418; **96**, 1130.

### CAPE FEAR TO WACCAMAW RIVER, N. C. (Waterway.) (See *Waccamaw River, N. C. and S. C.*)

**Engineers.**

Chief of Engineers. Report, **81**, 168.

Engineer in Charge. Capt. J. Mercur. Report, **82**, 1119.

Assistant. J. P. Darling. Report, **82**, 1120.

**Physical characteristics.**

Route described, **82**, 1121.

**Plans.**

Capt. Mercur estimated it would cost from $1,500,000 to $8,250,000, **82**, 1120.

**Survey.**

Ordered by act of Mar. 3, 1881, made under the direction of Capt. Mercur (report unfavorable—"cost virtually prohibitive"), **82**, 1119.

### CAPE FOULWEATHER HARBOR, OREG.

**Commerce.** (See *Plans.*)

**Engineers.**

Chief of Engineers. Reports, **78**, 139; **79**, 183.

Engineer in Charge. Maj. J. M. Wilson, **78**, 138; **79**, 180, 183. Report, **79**, 1796.

Assistant. R. A. Habersham, **79**, 1796. Report, **79**, 1799.

**Estimates.** (See *Plans.*)

By R. A. Habersham, 1879, breakwater 4,900 f. long, $4,606,132, **79**, 1798, 1801.

**Physical characteristics.**

Description of, **79**, 1796, 1797, 1799, 1800, 1802.

Tides and fogs, **79**, 1797, 1801.

Direction of prevailing winds, **79**, 1800.

**Plans.** (See *Estimates.*)

By Maj. Wilson, 1879, breakwater 9,900 f. long, $11,462,487, to form a harbor of refuge, **79**, 1798, 1801. Recommends breakwater north of cape instead of south, 600 f. long, $656,251, affording 50 to 100 acres of anchorage, **79**, 1798, 1799, 1801, 1802.

**Survey.**

Examination ordered, 1878, to ascertain adaptability for harbor of refuge, **78**, 139. Completed, 1879, by R. A. Habersham, **79**, 183, 1796.

### CAPE GIRARDEAU, Improvement of Mississippi River at. (See *Mississippi River between mouths of Illinois and Ohio Rivers.*)

### CAPE GREGORY, OREG. (See also *Pacific Coast, Harbor of Refuge.*)

**Engineers.**

Chief of Engineers. Report, **77**, 123.

Board of Engineers. Of the Pacific coast met in Aug., 1876, to "examine the harbors of Mendocino, Humboldt Bay, Trinidad, and Crescent City, Cal., with a view of establishing a breakwater and harbor of refuge." The Board reported that a safe harbor ½ square mile could be made at Cape Gregory. Report, **77**, 1055. (Lt. Cols. Alexander, Stewart, and Williamson, and Maj. Mendell.)

**Estimates.**

By Board of Engineers, breakwater, $3,710,168, **77**, 1059.

### CAPE HATTERAS. (See *Norfolk Harbor to the Atlantic.*)

### CAPE HENLOPEN. (See *Delaware Bay, Del.*)

### CAPE LOOKOUT, N. C., Harbor of refuge at.

**Commerce.**

During the nine years ending 1897 about $2,600,000 worth of vessels and cargoes was lost in the vicinity of Cape Lookout, **97**, 1431, **1900**, 1833.

**Engineers.**

Chief of Engineers. Reports, **95**, 191, **97**, 212, **1900**, 276.

Board of Engineers. Convened at Wilmington, N. C., Nov. 8, 1899, by S. O.,

## CAPE LOOKOUT, N. C., Harbor of refuge at—Continued.

No. 14, to make examination, survey, plan, and estimate for a harbor of refuge at or near Cape Lookout, N. C. Report, **1900**, 1830 (Majs. E. H. Ruffner, T. L. Casey, and Capt. E. W. Van C. Lucas).

ENGINEERS IN CHARGE:

Maj. W. S. Stanton, 1895. Report, **95**, 1375.

Capt. W. E. Craighill, 1897–. Report, **97**, 1430; **1900**, 1834.

ASSISTANTS:

Lt. E. W. Van C. Lucas. Report, **95**, 1379.

W. H. Chadbourn. Reports, **97**, 1432; **1900**, 1835.

**Physical characteristics.**

Description of, **95**, 1379; **1900**, 1832. The only refuge for vessels engaged in trade from Cape Fear to the capes of Virginia, **97**, 1433.

Comparative advantages at Cape Lookout and Cape Hatteras for a harbor of refuge, **1900**, 1831, 1832.

**Projects.**

Capt. Craighill submitted an estimate, 1897, for stone breakwater sheltering an area of 540 acres, with a depth of 30 f.; cross section the same as that for the breakwater in Delaware Bay, Del.; estimate, $3,700,000, **97**, 1430; **1900**, 1835.

Board of Engineers, 1899, estimated it would cost $3,526,600 to construct a breakwater on the line and general position as selected by Capt. Craighill, 1897, modified with regard to its exact location and the direction of the short outer tangent, **1900**, 1831.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made, 1895, under direction of Maj. Stanton (report favorable), **95**, 1376.

Survey, with view to make it capable of sheltering the largest vessels, ordered by act of June 3, 1896, made under the direction of Capt. Craighill, 1897 (see *Projects*), **97**, 1430.

MAPS. **97**, 1432.

## CAPE LOOKOUT, OREG.

**Engineers.**

CHIEF OF ENGINEERS. Report, **98**, 502.

ENGINEER IN CHARGE. Maj. W. L. Fisk, 1898. Report, **98**, 3001.

**Physical characteristics.**

Description of, **98**, 3002.

One of the prominent promontories of the Oregon coast, situated 60 miles south of the mouth of the Columbia River. The bottom is hard, poor holding ground for anchorage, and unsuited for a harbor of refuge, **98**, 3002.

**Project.**

In 1897 Capt. Fisk estimated it would cost $10,725,000 to construct a breakwater, **98**, 3003.

**Survey.**

Examination, with the view to the construction of a harbor of refuge and to ascertain its cost, ordered by act of June 3, 1896, made, 1897, by Capt. Fisk (report unfavorable) (see *Projects*), **98**, 3001.

## CAPE MAY CITY, N. J. (Breakwater).

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 118.

ENGINEER IN CHARGE. Maj. C. W. Raymond. Report, **91**, 1099.

**Physical characteristics.**

Description of, **91**, 1099.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Raymond (report unfavorable), **91**, 1099.

## CAPE MAY TO GREAT BAY, N. J. (Thoroughfare).

**Commerce.**

Unimportant, **88**, 728, 729.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **88**, 86; **91**, 118.

ENGINEERS IN CHARGE.

Lt. Col. H. M. Robert, 1888. Reports, **88**, 724, 730.

Maj. C. W. Raymond, 1891. Report, **91**, 1097.

ASSISTANT. L. Y. Schermerhorn. Reports, **88**, 725, 731.

**Physical characteristics.**

Description of, **88**, 724, 726; **91**, 1097.

**Plans.**

By Lt. Col. Robert, 1888, for excavating channel 50 f. wide and 6 f. deep at m. l. w. throughout the length of the thoroughfare running back of the ocean from Cape May to Great Bay, N. J., in removing 1,310,000 c. y.; estimate, by contract, $200,000; by hired labor, $130,000, **88**, 731.

**Surveys.**

Made, 1888, under direction of Lt. Col. Robert, **88**, 730.

Examination, 1890, by Maj. Raymond (report unfavorable), **91**, 1098.

MAPS. **88**, 734.

## CAPE PORPOISE HARBOR, ME.[a]

**Appropriations.**
1899, $70,000, **99**, 1045.
1900, 10,000, **1900**, 1146.

Total, 80,000

**Commerce.**
Description of, **95**, 583.

**Contracts.**
**1899.** G. F. Taylor, dredging, 9.2 cents per c. y., s. m. ($65,964), **1900**, 1147.

**Engineers.**
Chief of Engineers. Reports, **95**, 38; **99**, 58, 62; **1900**, 65.

Engineers in Charge.
Lt. Col. D. P. Heap, 1895. Report, **95**, 583.
Maj. S. W. Roessler, 1899. Reports, **99**, 1045, 1050.
Maj. W. L. Fisk, 1900–. Report, **1900**, 1146.

**Physical characteristics.**
Description of, **95**, 583; **99**, 1051.

**Operations.**
**1899–1900.** 45,878 c. y. dredged, **1900**, 1146.

**Projects.**
By Maj. Roessler, 1899, entrance channel 200 f. wide and 16 f. deep, m. l. t., and channel and anchorage within the harbor about 3,000 f. long, 600 f. wide, and 15 f. deep, m. l. t.; estimate (based on survey of civilian engineer), $125,000 (continuous contract), **99**, 1045.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made 1894 by Col. Hains (report favorable).) **95**, 583.

Congress, by concurrent resolution, 1898, asked for an estimate of the cost of improving the harbor. Report (favorable), rendered 1899, by Maj. Roessler. (See *Projects.*) **99**, 1050.

## CAPE VINCENT, N. Y.

**Appropriations.**
1896, $25,000, **96**, 3162.
1899, 25,000, **99**, 3146.

Total, 50,000

**Contract.**
**1899.** J. B. Donnelly, timber crib breakwater construction (timber, ironwork, excavation, and stone), $35,993.33, **1900**, 4174.

**Engineers.**
Chief of Engineers. Reports, **89**, 337; **96**, 381; **97**, 477; **98**, 466; **99**, 547; **1900**, 616.

Engineers in Charge.
Capt. C. F. Palfrey, 1888–89. Report, **89**, 2432.
Maj. W. S. Stanton, 1896–98. Reports, **96**, 3162; **97**, 3286; **98**, 2809.
Capt. G. D. Fitch, 1899–. Reports, **99**, 3145; **1900**, 4173.

Assistant. J. C. Churchill, jr. Report, **97**, 3289.

**Operations.**
**1899–1900.** About 5,000 c. y. dredged for breakwater crib foundations; over 1,400 y. stone laid in excavation; **1900**, 4173.

**Physical characteristics.**
Description of, **89**, 2432; **97**, 3286, 3287.

Cape Vincent is on the St. Lawrence River, 2½ miles below its head at the foot of Lake Ontario; the channel in that distance nearly three-fourths of a mile to 1¼ miles wide, straight and clear, **97**, 3287; channel dangerous to navigate at night, **97**, 3288.

**Projects.**
By Capt. Palfrey, 1889, for building a breakwater 1,600 f. parallel to and 600 f. from the front of the railroad dock; estimate, $320,000, **96**, 3162.

By Maj. Stanton, 1897, for a timber crib breakwater 1,500 f. long, including 100-f. return at the upper end; cribs to be 100 f. long, 27 f. wide, and 22 f. deep, each to be ballasted with about 2,500 tons of stone (drawings); estimate, $200,000; **97**, 3287; **99**, 3145.

By Capt. Fitch, 1899, for application of available funds to construction of about 350 f. of breakwater, **99**, 3145.

**Surveys.**
Examination for a breakwater, ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Palfrey (Chief of Engineers' report unfavorable), **89**, 2432.

A survey of the site for the breakwater was made by Maj. Stanton in 1896–97, **97**, 3286.

Maps, **97**, 3288.
Drawings, **99**, 3146.

## CAPISTRANO POINT, CAL. (Deep-water harbor bet een Point Duine and). (See also *San Pedro* and *Santa Monica Bays.*)

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[a] Survey—Report, Oct. 2, 1845; estimate, $24,161.17. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CARLIN BAYOU, LA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 229.

ENGINEER IN CHARGE. Maj. J. P. Quinn. Report, **91**, 1838.

**Physical characteristics.**

Description of, **91**, 1838.

**Survey.**

Examination, ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Quinn (report unfavorable), **91**, 1838.

## CARONDELET CANAL, LA.[a]

**Appropriation.**

1809, $25,000.

## CARP RIVER, MICH. (See *Leland Harbor, Mich.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 2208.

ENGINEER IN CHARGE. Capt. D. W. Lockwood, 1887. Report, **87**, 2208.

**Survey.**

Examination, with view to affording an entrance to Carp Lake for a harbor of refuge, ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Lockwood (report unfavorable—"impractical") **87**, 2208.

## CARQUINEZ STRAIT, CAL. (See *Karquines* and *Surveys.*)

## CARRABELLE-BAR AND HARBOR, FLA. (See *Crooked River, Fla.; Dog Island Harbor.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1896, | $10,000, | **97**, | 1604. |
| 1899, | 10,000, | **99**, | 1648. |
| Total, | 20,000 | | |

**Commerce.**

Description of, **95**, 1680–1682; **1900**, 2156.

In 1895 it amounted to $600,000 per year, **95**, 1680.

Value of commerce, 1898–99, $382,000; prospective commerce, $1,030,000, if harbor and pass were improved, **1900**, 2153.

**Contracts.**

**1897.** R. Moore Dredging Co., dredging, 30 cents per c. y., **97**, 1604.

**1899.** National Dredging Co., dredging, 27 cents per c. y. ($8,640), **1900**, 2089.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 235; **96**, 198; **97**, 253; **98**, 249; **99**, 288, 302; **1900**, 328, 343.

ENGINEERS IN CHARGE:

Maj. F. A. Mahan, 1895–98. Reports, **95**, 1680; **97**, 1603; **98**, 1375.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1647; **1900**, 2088, 2152, 2157.

ASSISTANTS:

Lt. C. P. Echols. Report, **95**, 1681.

Lt. L. H. Rand. Report, **1900**, 2155.

**Operations.**

**1897–98.** 30,592 c. y. dredged, **98**, 1376.

**1899–1900.** 32,000 c. y. dredged, **1900**, 2089.

**Physical characteristics.**

Description of, **95**, 1681, 1682.

The harbor much more advantageously situated for trade than Apalachicola on account of being nearer the anchorage grounds for seagoing vessels, **95**, 1680.

Description of, East Pass, **1900**, 2153.

**Projects.**

By Maj. Mahan, 1895, for a 10-f. channel from the mouth of the Carrabelle River to the channel in the bay, **97**, 1604.

Capt. Flagler estimated, 1900, it would cost $24,900 to complete the work, **1900**, 2089.

Capt. Flagler estimated, 1899, it would cost $27,450 to dredge a channel, East Pass, as proposed, and to close a breach recently made through Dog Island, **1900**, 2157.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made under direction of Maj. Mahan, 1895 (report favorable; see *Projects*), **95**, 1680.

Examination made, 1898, by Maj. Mahan, **98**, 1376.

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[a] For deepening, to allow passage of gunboats from Lake Pontchartrain, by way of the Bayou St. John, to the city of New Orleans, and, by an extension of the canal, to the Mississippi River, if, after survey, the work be found practicable. Cost to complete the canal estimated, 1827, at $974,304 (Treasury Doc. 373, 1882). This survey was probably not made under the direction of the War Department (H. R. Doc. No. 482, p. 2.)

## CARRABELLE BAR AND HARBOR, FLA.—Continued.

Estimate of cost of completion authorized by Chief of Engineers, June 18, 1900, made, 1900, by Capt. Flagler (see *Projects*), **1900**, 2089.

Examination and survey of East Pass, at the entrance of Carrabelle Harbor, Fla., with view to obtain 22-f. channel, m. l. w., ordered by act of Mar. 3, 1899. Examination only made, 1899, under direction of Capt. Flagler (report favorable), **1900**, 2153.

Plan and estimate of cost of obtaining a 20½-f. channel, m. l. w., 150 f. wide through East Pass, at the entrance of Carrabelle Harbor, Fla., authorized July 19, 1899, by the Secretary of War; made, 1899, by Capt. Flagler (see *Projects*), **1900**, 2157.

## CARRLS RIVER, N. Y.

**Commerce.**
None, and none expected, **95**, 1004.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **95**, 121.
ENGINEER IN CHARGE. Capt. T. L. Casey, 1895. Report, **95**, 1003.

**Physical characteristics.**
One of the many creeks draining the uplands down into Great South Bay, Long Island, **95**, 1003.

**Private work.**
Estimated, 1895, that about $5,000 had been spent by private enterprise in the improvement of the stream, **95**, 1004.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made by Capt. Casey, 1894 (report unfavorable), **95**, 1003.

## CARTERS CREEK, VA.

**Commerce.**
Description of, **1900**, 1750, 1751.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 223, **1900**, 254.
ENGINEER IN CHARGE. Lt. Col. C. J. Allen, 1900–. Reports, **1900**, 1747, 1750.

**Physical characteristics.**
Description of; creek on the left bank of the Rappahannock River; general characteristics of a tidal estuary rather than that of a tributary, **1900**, 1751.

**Projects.**
Lt. Col. Allen, estimated, 1899, it would cost $33,900 for a channel 200 f. wide, or $26,500 if the width were reduced to 150 f.; he also submitted an estimate, by request of the citizens of the locality, for improving the Eastern Branch near Gallyhook Point at a cost of about $1,700 or $1,800, **1900**, 1751, 1752.

**Surveys.**
Examination and survey, with view to improving mouth of creek, ordered by act of Mar. 3, 1899, made, 1899, by Lt. Col. Allen (report favorable; see *Projects*), **1900**, 1748, 1750.

## CARTHAGE. (See *Pearl River, Miss.*)

## CARVERS HARBOR (VINALHAVEN), ME.

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $10,000, | **96**, 559. |
| 1899, | 15,000, | **99**, 1037. |
| Total, | 25,000 | |

**Contracts.**
**1897.** Moore & Wright, dredging, 15 cents per c. y., s. m. ($11.250), **98**, 826.
**1899.** A. R. Wright, dredging, 14.5 cents per c. y., s. m.; bowlder removal, $5 per short ton ($17,400), **1900**, 1093.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 37; **95**, 39; **96**, 32; **97**, 34; **98**, 44; **99**, 52; **1900**, 56.
ENGINEERS IN CHARGE:
Lt. Col. P. C. Hains, 1892–93. Report, **93**, 725.
Lt. Col. D. P. Heap, 1895. Report, **95**, 587.
Lt. Col. A. N. Damrell, 1896. Report, **96**, 558.
Maj. R. L. Hoxie, 1897–98. Reports, **97**, 785; **98**, 826.
Maj. S. W. Roessler, 1899–. Reports, **99**, 1037; **1900**, 1092.
ASSISTANT. A. C. Both. Report, **95**, 589.

**Operations.**
**1897–98.** 60,000 c. y. dredged, **98**, 826.
**1899–1900.** 97,014 c. y. dredged, **1900**, 1092.

**Physical characteristics.**
Description of, **93**, 726; **96**, 558.

**CARVERS HARBOR (VINALHAVEN), ME.**—Continued.

**Projects.**

By Lt. Col. Heap, 1895, for dredging the inner harbor to a depth of 16 f.; estimate, $64,000, **96**, 559.

**Surveys.**

Examination ordered by act of July 13, 1892, made by Lt. Col. Hains in 1892 (report partly favorable), **93**, 725.

Survey ordered by act of Aug. 17, 1894, made by Maj. Heap, 1895 (see *Projects*), **95**, 587.

**CASCADES, COLUMBIA RIVER, OREG. (Canal).** (See *Columbia River at the Cascades.*)

**CASEVILLE, MICH.** (See *Pigeon River.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 301; **84**, 308.

ENGINEER IN CHARGE. Maj. F. U. Farquhar. Report, **84**, 2077.

ASSISTANT. C. P. Gilbert. Report, **84**, 2077.

**Survey.**

Examination ordered by act of Aug. 2, 1882, made under direction of Maj. Farquhar (report unfavorable), **84**, 2077.

**CASHIE RIVER, N. C.**

**Commerce.**

About $80,000 worth of merchandise carried on the river annually; not of such a character as to warrant improvement of the stream, **97**, 1382.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 164; **97**, 199.

ENGINEERS IN CHARGE:

Capt. F. A. Hinman. Reports, **85**, 1053, 1054.

Capt. T. L. Casey, 1897. Report, **97**, 1381.

ASSISTANT. H. C. Collins. Reports, **85**, 1053, 1055.

**Physical characteristics.**

Description of, **85**, 1056; **97**, 1381.

**Plans.**

By Capt. Hinman, 1885, removal of snags, wrecks, and similar obstructions, mouth to Windsor, 25 miles. Estimate, $30,000. **85**, 1055, 1058.

**Surveys.**

Examination ordered by act of July 5, 1884, made under the direction of Capt. Hinman, **85**, 1053, 1054.

Examination ordered by act of June 3, 1896, made, 1896, by Capt. Casey (report unfavorable), **97**, 1381.

**CASSIDY (CASSIDY'S) BAYOU, MISS.** (See *Coldwater River, Miss.*)

**Commerce.**

Small, **85**, 1534, 1537.

Description of; unimportant, **93**, 2096.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 243; **87**, 203; **93**, 272.

ENGINEERS IN CHARGE:

Capt. E. Bergland. Report, **85**, 1534.

Capt. J. H. Willard, 1887–93. Reports, **87**, 1497; **93**, 2095.

ASSISTANT. F. S. Burrows. Report, **85**, 1535.

**Legislation.**

Act of Mississippi, 1886, incorporated the Cassidy Bayou Dam and Lock Co., having right to improve and navigate the stream for 30 years, **93**, 2097.

**Physical characteristics.**

Bayou described, **85**, 1535; **93**, 2096.

**Plans.**

Capt. Bergland reported the removal of snags and similar obstructions, 44 miles of bayou, mouth to Hopsons Bayou, would cost $8,800, **85**, 1534, 1537.

In 1887 Capt. Willard recommended expending $5,000 to clear the bayou from snags to 50 miles above the mouth, **87**, 1497.

**Projects.**

Snag removal advised if the charter of the dam company should be revoked, **93**, 2096.

**Surveys.**

Examination ordered by acts of July 5, 1884, and Aug. 5, 1886, made under the direction of Capt. Bergland (report unfavorable), 1885, **85**, 1534, and Capt. Willard in 1886, **87**, 1497.

Examination ordered by act of July 13, 1892, made, 1893, by Capt. Willard (report unfavorable), **93**, 2095.

## CASTAIN BAYOU, LA.[a]

## CASTLE HAINE, N. C. (See *Northeast River.*)

## CASTOR BAYOU, LA.

**Commerce.**
Description of, **95**, 1965.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **91**, 249; **95**, 279.
ENGINEER IN CHARGE. Capt. J. H. Willard, 1891-95. Reports, **91**, 2028; **95**, 1962.
ASSISTANT. R. S. Buck. Report, **91**, 2029.

**Physical characteristics.**
Description of, **91**, 2029; **95**, 1963, 1964.
Chief function of the stream to drain the neighboring country, **95**, 1963, 1964.

**Surveys.**
Examination ordered by act of Sept. 19, 1890; made, 1890, under direction of Capt. Willard (report unfavorable), **91**, 2028.
Examination ordered by act of Aug. 17, 1894; report (unfavorable) submitted by Capt. Willard, 1895, **95**, 1962.

## CATAWBA RIVER, N. C.[b] (See *Santee and Wateree rivers.*)

**Commerce.**
Comparatively unimportant, **76**, 372, 373.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **76**, 69; **79**, 95; **80**, 125; **87**, 139; **88**, 134.
ENGINEERS IN CHARGE:
S. T. Abert, U. S. C. E., **76**, 68. Report, **76**, 367.
Capt. C. B. Phillips, 1880. **79**, 88. Report, **80**, 911.
Capt. W. H. Bixby. Reports, **88**, 958, 561, 562.
ASSISTANTS:
J. M. Wolbrecht. Reports, **80**, 912, 913.
Lt. H. Taylor. Report, **88**, 965.

**Estimates.** (See *Plans.*)
By S. T. Abert, 1875, locks, dams, and dredging, $1,346,900, **76**, 375.

**Physical characteristics.** (See note to title.)
Description of, **76**, 367, 368, 372, 374; **88**, 959, 963, 965.
Distances and levels, **76**, 369, 370.

**Plans.** (See *Estimates.*)
By S. T. Abert, 1876, lateral dams and removal of obstructions; not recommended. Slack-water navigation by means of locks and dams; too costly. Recommends surveys before determining plans. **76**, 374, 375.

**Surveys.**
From Moores Shoals to State line, 1824, by H. Fulton, **76**, 368.
Examination by S. T. Abert, 1875, from South Carolina line to Old Fort, N. C., **76**, 69, 367.
Ordered by act of June 18, 1878; made, in 1880, under direction of Capt. Phillips (report unfavorable—"costly"), **80**, 911.
Previous examination, 1875, by S. T. Abert, **76**, 374; **80**, 912.
Examination ordered by act of Aug. 5, 1886; made, 1887, under direction of Capt. Bixby (report unfavorable), **88**, 958.

## CAT CREEK, VA. (See *Franklin City.*)

## CATHANCE RIVER, ME.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $10,000, | **80**, 333. |
| 1881, | 6,000, | **81**, 483. |
| 1882, | 5,000, | **82**, 495. |
| Total, | 21,000 | |

**Commerce.**
Benefit to commerce from improvement, **81**, 483.

**Contracts.**
**1880.** W. W. Wright, dredging, 27 cents per c. y., **81**, 484; completed, **81**, 482. Eastern Dredging Co., dredging, 21 cents per c. y., **81**, 484; completed, **82**, 495.
**1882.** Kennebec Dredging Co., dredging, 34 cents per c. y., **83**, 418; completed, **84**, 465.

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[a] Survey, harbor of refuge—Report, Feb. 27, 1880. Estimate, $3,410. (H. Doc. 482, 55th Cong., 2d sess.)

[b] Below mouth of Wateree Creek this stream is known as the "Wateree," and farther down, at confluence of Wateree and Congaree rivers, it becomes the Santee.

## CATHANCE RIVER, ME.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 65, 71; **81**, 67; **82**, 66; **83**, 61: **84**, 70.

ENGINEERS IN CHARGE:

Col. G. Thom, 1879–83. Reports, **80**, 332, 354; **81**, 482; **82**, 495.

Col. C. E. Blunt, 1883–84. Reports, **83**, 417; **84**, 465.

ASSISTANT. E. C. Jordan. Report, **80**, 355.

**Operations.**

**1880–81.** 31,347 c. y. dredged, **81**, 482.

**1881–82.** 27,922 c. y. dredged, **82**, 495.

**1882–83.** 9,450 c. y. dredged, **83**, 417.

**1883–84.** Contract with Kennebec Dredging Co., dredging, completed, **84**, 465. Improvement completed, **84**, 465.

**Projects.**

By Col. Thom, 1879, for improving river at its junction with the Kennebec, by dredging a channel with a depth of 10 f. at m. l. w. and a width of not less than 200 f. from the outlet of the river into Merry Meeting Bay to the channel of the Kennebec River, near "The Chops," about 2½ miles, estimate, $25,000, **81**, 67.

**Survey.**

Ordered by act of March 3, 1879, **79**, 52; made, 1880, under the direction of Lt. Col. Thom, **80**, 354, 355.

MAPS. **80**, 332.

## CATSKILL CREEK, N. Y.

**Commerce.**

Description of; the town of Catskill, situated at the mouth, had a commerce estimated at not less than 250,000 tons annually in 1896, **97**, 1042.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 114.

ENGINEER IN CHARGE. Lt. Col. W. Ludlow, 1897. Report, **97**, 1041.

ASSISTANT. A. Doerflinger. Report, **97**, 1042.

**Physical characteristics.**

Description of; creek a tributary of the Hudson River, entering it at Catskill, 10 miles below the city of Hudson, **97**, 1041.

**Survey.**

Examination ordered by act of June 3, 1896, made, 1896, by Col. Gillespie (report partly favorable), **97**, 1041.

## CATTARAUGUS CREEK, N. Y.[a]

**Appropriations.**[b]

1836, $15,000, July 4.
1837, 10,000, Mar. 3.
1838, 32,410, July 7.

Total, 57,410

## CAVALLO HARBOR AND PASS, TEX. (See also *Matagorda Bay* and *Surveys*.)

## CEDAR BAYOU, TEX.

**Appropriations.**

1890, $18,150, **91**, 1923.
1892, 14,000, **92**, 1545.

Total, 32,150

**Commerce.**

Important, **75**, 943, 944.
Transportation, **87**, 1436.

**Contracts.**

**1891.** A. M. Shannon & Co., dredging, 24 cents per c. y.; brush mattress in place, $6 per cord; stone in place, $2.50 per c. y., **92**, 1545.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 80; **87**, 193; **89**, 207; **90**, 186; **91**, 233; **92**, 227; **93**, 256; **94**, 236; **95**, 264.

ENGINEERS IN CHARGE:

Capt. C. W. Howell, 1975. **75**, 79. Report, **75**, 941.

Maj. O. H. Ernst, 1887–90. Reports, **87**, 1435; **90**, 1815.

Maj. C. J. Allen, 1888–92. Reports, **90**, 1816; **91**, 1922; **92**, 1543.

Maj. A. M. Miller, 1893–95. Reports, **93**, 1883; **94**, 1405; **95**, 1815.

ASSISTANT. R. B. Talfor, **75**, 929. Reports, **90**, 1817; **92**, 1546; **93**, 1884; **94**, 1407.

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[a] Survey—Report, 1835; estimate, $55,712.17. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] For improving the harbor at the mouth of. (Treasury Doc. 373, 1882).

## CEDAR BAYOU, TEX.—Continued.

**Operations.**

**1891–92.** 10,350 c. y. dredged; 833 cords of brush mattress and 2,278 c. y. stone in place, **92**, 1545.

**1892–93.** South jetty extended 517 l. f. and north jetty 325 l. f., **93**, 1884.

**1893–94.** 21,000 c. y. dredged, **94**, 1406.

**Physical characteristics.**

Description of, **75**, 942.

Deterioration of channel from natural causes, **87**, 1436.

**Plans.** (See *Projects.*)

By Capt. Howell, 1874, a channel 100 f. by 5 f. across the bar; estimate, $5,750, **75**, 942.

Maj. Ernst, 1887, estimates $48,875 cost of channel excavation, **87**, 1436.

By Maj. Allen, 1889, excavation of a channel through the bar at the mouth of the bayou, dredging and revetment; 5-f. channel, $18,150 to $20,735; 6-f. channel, $24,035 to $51,700, **90**, 1817, 1818.

**Projects.** (See *Plans.*)

By Maj. Allen, 1889, dredging a channel 100 f. wide and 5 f. deep at m. l. w.- protection of the channel thus formed with brush and stone walls or revetment, with occasional dredging to maintain the channel depth; estimate, $32,500, **91**, 1923; **92**, 1544.

In 1892–93 Maj. Miller estimated the cost of the existing project should be increased by $6,500, **93**, 1883.

**Surveys.**

By R. B. Talfor of bar in Galveston Bay near mouth of the San Jacinto River, 1874, **75**, 80.

Examination ordered by act of Aug. 5, 1886, made, 1887, under direction of Maj. Ernst, **87**, 1435.

Survey for removal of bar at mouth ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Allen, **90**, 1816.

## CEDAR CITY, MO. (See *Missouri River between mouth and Sioux City.*)

## CEDAR CREEK, DEL. (See *Inland waterway connecting Mispillion and Broadkill rivers, Del.*)

**Commerce.**

Annual commerce in 1896 amounted to $51,900, **97**, 1294.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 171.

ENGINEER IN CHARGE. Maj. W. F. Smith, U. S. agent, 1896. Report, **97**, 1293.

**Physical characteristics.**

Description of, **97**, 1294.

**Survey.**

Examination ordered by act of June 3, 1896, report (unfavorable) submitted, 1896, by Maj. Smith, **97**, 1293.

## CEDAR KEYS HARBOR, FLA. (See *Clearwater Harbor, Fla.; Hillsboro Bay and River, Fla.; Tampa Bay, Fla.*)

**Appropriations.**

| | | |
|---|---|---|
| 1872, | $7,500, | **73**, 67; **74**, 75. |
| 1875, | 15,000, | **75**, 80. |
| 1876, | 10,000, | **76**, 72. |
| 1878, | 20,000, | **78**, 79. |
| 1879, | 15,000, | **79**, 101. |
| 1880, | 15,000, | **80**, 1070. |
| 1884, | 5,000, | **84**, 197. |
| 1886, | 7,000, | **86**, 1149. |
| 1888, | 7,500, | **88**, 1118. |
| 1890, | 2,500, | **90**, 1610. |
| Total, | 104,500 | |

**Commerce.**

Limited, **73**, 722, 725.

Decline in, **90**, 1610.

In 1894, commerce declining, primary object for the improvement did not exist, **94**, 1245.

In 1896 the commerce not sufficient to warrant an improvement of the harbor, **97**, 1584.

**Contracts.**

**1874.** J. E. Slaughter, dredging, 99 cents per c. y., **75**, ii, 7.

**1875.** J. E. Slaughter, dredging, 59½ and 92 cents per c. y., **76**, 492; **77**, 412.

**1877.** J. E. Slaughter, dredging, 59½ and 92 cents per c. y., **78**, 589.

**1880.** J. E. Slaughter, dredging, 69 cents per c. y., **80**, 1070; completed, **81**, 1180. J. E. Slaughter, removing wreck of steamer Lewisburg, at $1,999, **80**, 1070; completed, **81**, 1180.

**1881.** J. E. Slaughter, dredging, 67 cents per c. y.; completed, **81**, 1181.

**1884.** S. N. Kimball, dredging and rock excavation, $1 and $6.50, respectively, per c. y., **85**, 1271.

**1887.** R. Moore, dredging, 45 cents per c. y., **87**, 1252.

**1889.** D. G. Ambler, dredging, 29 cents per c. y., **89**, 348.

**Engineers**

CHIEF OF ENGINEERS. Reports, **72**, 64; **73**, 67; **74**, 75, **75**, 80, **76**, 71; **77**, 70;

## CEDAR KEYS HARBOR, FLA.—Continued.

**78**, 79; **79**, 101; **80**, 133; **81**, 181; **84**, 206; **85**, 196; **86**, 195; **87**, 161; **88**, 149; **89**, 172; **90**, 155; **91**, 193; **92**, 191; **93**, 209; **94**, 194; **97**, 252.

ENGINEERS IN CHARGE:

Col. J. H. Simpson, 1872. **72**, 64; **73**, 66.

Lt. Col. W. F. Raynolds, 1873. **73**, 66.

Capt. A. W. Damrell, 1873–85. **73**, 66. Reports, **73**, 721; **74**, 895; **75**, ii, **7**; **76**, 492; **77**, 412; **78**, 589; **79**, 812; **80**, 1069; **81**, 1180; **84**, 1218, 1220, 1223.

Capt. W. T. Rossell, 1885–86. Report, **85**, 1270.

Lt. W. M. Black, 1886–92. Reports, **86**, 1148; **87**, 1251; (Capt.), **88**, 1116; **89**, 1347; **90**, 1609; **91**, 1661.

Maj. J. C. Mallery, 1892. Report, **92**, 1392.

Lt. A. M. D'Armit, 1893. Report, **93**, 1676.

Maj. T. H. Handbury, 1894. Report, **94**, 1244.

Lt. Col. W. H. H. Benyaurd, 1897. Report, **97**, 1583.

ASSISTANTS:

G. Jaenicke. Report, **73**, 723.

C. F. Geisinger, **73**, 721.

Lt. J. L. Lusk. Report, **84**, 1219, 1220.

H. Harding. Report, **84**, 1226.

Lt. J. J. Meyler. Report, **97**, 1584.

**Operations.**

**1872–73.** Survey made, **73**, 67.

**1874–75.** 6,69[illegible] c. y. dredged (channel cut 1,350 f. by 60 f. by 12 f.), **75**, 80, ii, 7.

**1875–76.** 24,045 c. y. dredged (channel completed through outer bar), **76**, 72, 493.

**1877–78.** 14,221 c. y. dredged (channel 80 f. by 11.5 f. between Depot Key and Way Key), **78**, 79, 589.

**1878–79.** 24,748 c. y. dredged (channel 200 f. by 11.5 f. through Middle Ground), **79**, 101, 813.

**1879–80.** Wreck of steamer *Lewisburg* removed and 14,273 c. y. dredged on outer bar, **80**, 1069.

**1880–81.** 33,968 c. y. dredged, **81**, 1180, 1181.

**1885–86.** 370 c. y. sand and 6,153 c. y. stone removed, **86**, 1149.

**1887–88.** 12,945 c. y. dredged, **88**, 1117.

**1889–90.** 9,180 c. y dredged, **90**, 1610.

**1890–91.** 19,055 c. y. dredged, **91**, 1662.

**1891–92.** 3,962 c. y. dredged, **92**, 1392.

**Physical characteristics.**

Description of, **73**, 721, 722, 724, 725; **78**, 813; **89**, 1347.

Soundings and tide observations, **73**, 724.

**Plans.** (See *Projects*.)

By G. Jaenicke, 1873. 1st, dredging channel 12 f. deep and 150 f. wide from the 12-f. curve outside to the same inside; estimate, $17,923, **73**, 722, 726. 2d, channel same width and depth as foregoing across the bend of the river below and to the westward of Harbor Key; estimate, $115,578, **73**, 722, 726.

**Projects.** (See *Plans*.)

By Capt. Damrell, 1873, dredging a channel 100 f. wide by 10 f. deep across the bend at the proposed line; estimate, $37,510, **73**, 721, 722; **75**, 80, ii, 7; modified to channel 200 f. wide and improving channels inside of Sea Horse Key and at the bend between Depot Key and Harbor Key, **75**, ii, 7; **76**, 72, 493. For channel through Middle Ground 200 f. long by 80 f. wide and 10 f. deep, **78**, 589; **79**, 813; **87**, 1251. For removal of the wreck of the steamer *Gettysburg*, **79**, 101, 813.

By Capt. Damrell, 1884, widening the channel formed in 1872–81 through the Middle Ground to a width of 200 f. and depth of 10½ f., by dredging and rock removal; estimate, $25,000, **85**, 196, 1270; revised in 1887 to $66,000, on account of increased quantity of rock to be removed, **87**, 1252.

In 1891 Capt. Black reported further improvement undesirable, decreasing commercial importance of the locality, **91**, 1662; **92**, 1392.

**Surveys.**

Ordered, **72**, 64; completed by G. Jaenicke, **73**, 67, 721, 723.

Examination for harbor at Cedar Keys and also for channel inside the shoals along the coast of Florida, from Cedar Keys to Clearwater Harbor and Tampa, ordered by act of Aug. 2, 1882, made under direction of Capt. Damrell (report unfavorable), **84**, 1218, 1220.

Of harbor at Cedar Keys ordered by act of Aug. 2, 1882, made, 1884, under direction of Capt. Damrell, **84**, 1224.

Examination was ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd (report unfavorable), **97**, 1583.

MAPS. **86**, 1149; **88**, 1118.

## CEDAR KEYS TO CLEARWATER HARBOR, FLA.

**Commerce.**
Small, **84**, 1220.

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 206.
ENGINEER IN CHARGE. Capt. A. N. Damrell. Report, **84**, 1220.
ASSISTANT. Lt. J. L. Lusk. Report, **84**, 1220.

**Physical characteristics.**
Route described, **84**, 1220.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Damrell (report unfavorable), **84**, 1220.

## CEDAR POINT. (See *Westport, Conn.*)

## CEDAR POINT AND DAUPHIN ISLAND, ALA. (See *Dauphin Island and Cedar Point; Pass au Heron.*)

## CEDAR RIVER HARBOR, MICH.

**Appropriations.**
1882, $15,000, **82**, 2119.
1884. 15,000, **84**, 1834.

Total, 30,000

**Commerce.**
Unimportant, **87**, 2004.
Small, **88**, 1836; **91**, 2526; **94**, 2044.

**Contracts.**
**1883.** Green Bay Dredging Co., pile-pier construction, **83**, 1638.
**1884.** Green Bay Dredging Co., dredging, **85**, 1976. Schwarz & Berner, pile-pier construction, **85**, 1976.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **81**, 279; **82**, 268; **83**, 277; **84**, 276; **85**, 299; **86**, 293; **87**, 258; **88**, 236; **89**, 275; **90**, 248; **91**, 318; **92**, 303; **93**, 345; **94**, 315; **95**, 353; **96**, 309.
ENGINEERS IN CHARGE:
Maj. H. M. Robert, 1881–83. Reports, **82**, 2119, 2120.
Maj. J. W. Barlow, 1883. Report, **83**, 1629.
Capt. F. A. Hinman, 1883–84. Report, **83**, 1637.
Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1833; **85**, 1976.
Capt. W. L. Marshall, 1886. **86**, 290.
Capt. C. E. L. B. Davis, 1886–92. Reports, **86**, 1650; **87**, 2002; (Maj.), **88**, 1835; **89**, 2043; **90**, 2327; **91**, 2525.
Maj. J. F. Gregory, 1892–94. Reports, **92**, 2172; **93**, 2701; **94**, 2043.
Capt. C. F. Palfrey, 1895. Report, **95**, 2593.
Capt. G. A. Zinn, 1896. Report, **96**, 2458.
ASSISTANT. L. Y. Schermerhorn. Reports, **82**, 2122; **83**, 1639.

**Operations.**
**1883–84.** 563 l. f. of pile pier built, **84**, 1833.
**1884–85.** Pier construction in progress; 10,583 c. y. dredged from channel, **85**, 1976.
**1885–86.** Piers extended to an aggregate length of 1,054 f., **86**, 1650.

**Physical characteristics.**
Description of, **82**, 2120, 2122.
Shoal, front of entrance, **82**, 2119, 2212; **83**, 1639.
In 1894 there was a narrow channel with a depth of 14 f., **94**, 2044.

**Projects.**
By Maj. Robert, 1881, two parallel piers, 200 f. apart, extending from the outer ends of existing private piers to about the 16-ft. curve in Green Bay; dredging of the channel between the piers to the depth of 14 f.; estimate, $138,000, **82**, 2121, 2124. Change in direction of piers, **85**, 1976; **92**, 2172.

**Surveys.**
Ordered by act of Mar. 3, 1881, made under direction of Maj. Robert, **82**, 2119.
Survey made, 1894, by Maj. Gregory, **94**, 2044.
MAPS. Mouth of the river, **84**, 1834.

## CELILO FALLS. (See *Columbia River.*)

## CENTERVILLE CREEK, WIS.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 286.
ENGINEER IN CHARGE. Maj. C. E. L. B. Davis. Report, **89**, 2102.

**Plans.**
In 1888 Maj. Davis reported the present or prospective commerce did not warrant the required improvement, **89**, 2103.

## CHAGRIN RIVER, OHIO.

**Commerce.**
None of importance, **81**, 2340; **87**, 2334.

**Engineers.**
Chief of Engineers. Reports, **80**, 228; **81**, 314; **89**, 328.

Engineers in Charge:
Maj. J. M. Wilson. Report, **81**, 2339.
Maj. L. C. Overman. Reports, **87**, 2333; **89**, 2337.

**Physical characteristics.**
Description of, **89**, 2337.

**Plans.**
By Maj. Wilson, 1881, diverting stream into main channel by cutting off west branch at its head; two piers, 1,400 and 1,300 f. long, respectively; to extend into lake on either side of main channel, and for dredging between piers. Estimate, $200,420, **81**, 2339, 2340.

**Surveys.**
Ordered by act of June 14, 1880, made, 1880, under direction of Maj. Wilson, **80**, 228.

Examination of mouth ordered by act of Aug. 5, 1886, made under direction of Maj. Overman (report unfavorable), **87**, 2333.

Examination (near Willoughby) ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Overman (report unfavorable), **89**, 2336.

## CHAMPLAIN. (See *Lake Champlain.*)

## CHAMPLAIN LAKE AND MEMPHREMAGOG LAKE CANAL.[a]

## CHAMPLAIN RIVER, N. Y.

**Commerce.**
Description of, **84**, 2165.

**Engineers.**
Chief of Engineers. Report, **84**, 330.
Engineer in Charge. Maj. W. McFarland, 1884. Report, **84**, 2165.
Assistant: J. A. Gillespie. Report, **84**, 2166.

**Physical characteristics.**
Description of, **84**, 2166.

**Survey.**
Examination from Lake Champlain to Champlain Town, ordered by act of Aug. 2, 1882, made, 1882, under direction of Maj. McFarland (favorable, but improvement not a necessity), **84**, 2165.

## CHAMPLINS CREEK, N. Y.

**Commerce.**
None, **91**, 943.

**Engineers.**
Chief of Engineers. Report, **91**, 943.
Engineer in Charge. Lt. Col. G. L. Gillespie. Report, **91**, 943.

**Physical characteristics.**
Description of, **91**, 943.

**Survey.**
Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Gillespie (report unfavorable), **91**, 943.

## CHANDLERS RIVER, ME.

**Commerce.**
Description of, **97**, 799.

**Engineers.**
Chief of Engineers. Report, **97**, 42.
Engineer in Charge. Maj. R. L. Hoxie, 1897. Report, **97**, 798.

**Physical characteristics.**
Description of, **97**, 799.

**Survey.**
Examination ordered by act of June 3, 1896, made by Lt. Col. Damrell, 1897 (report favorable to survey), **97**, 798.

## CHAPEL POINT HARBOR (PORT TOBACCO CREEK [RIVER]), MD.

**Commerce.**
Unimportant, **95**, 1254; **97**, 1352.

**Engineers.**
Chief of Engineers. Reports, **84**, 163; **95**, 166; **97**, 189.

Engineers in Charge:
S. T. Abert, U. S. agent. Report, **84**, 163.
Maj. C. E. L. B. Davis, 1892–95. Report, **95**, 1252.

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[a] Survey.—Report, Dec. 1, 1825; estimates, $306,419.84 and $358,751.54. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CHAPEL POINT HARBOR (PORT TOBACCO CREEK [RIVER]), MD.—Continued.

Lt. Col. C. J. Allen, 1896. Report, **97**, 1350.

**Physical characteristics.**

Description of, **95**, 1253; **97**, 1351.

**Projects.**

Lt. Col. Allen, 1897, submitted estimates for channels of 10 and 15 f. depths over two different routes from wharf at Chapel Point to the channel of the Potomac River, $52,800 to $330,000, **97**, 1350.

**Surveys.**

Examinations ordered by act of Aug. 2, 1882, made, 1882, under direction of S. T. Abert (improvement not a necessity), **84**, 1008.

Examination ordered by act of Aug. 17, 1894, made by Maj. Davis, 1894 (report unfavorable), **95**, 1253.

Survey ordered by act of June 3, 1896, made by Lt. Col. Allen, 1896 (report unfavorable), **97**, 1350.

## CHARENTON CANAL, LA. (See *Teche Bayou.*)

## CHARLES RIVER, MASS. (See *Boston Harbor, Mass.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 46; **79**, 52.

ENGINEER IN CHARGE. Lt. Col. G. Thom, **78**, 46; **79**, 52. Report, **79**, 290.

ASSISTANT. R. A. Shailer. Report, **79**, 292.

**Physical characteristics.**

Description of, **79**, 291, 292.

Rise and fall of tide, **79**, 291, 292.

**Plans.**

By R. A. Shailer, 1879, dredging channel 100 f. wide by 6 f. deep from Western avenue bridge to Market street bridge; also a channel 75 f. wide and 3 f. deep from latter point to head of tide water; estimate, $70,000, **79**, 292, 293.

By Lt. Col. Thom, 1879, dredging, the same as above, with the addition of a channel, from mouth to Western avenue bridge, 200 f. wide by 7 f. deep; estimate, $85,000, **79**, 291.

**Surveys.**

Ordered and in progress, **78**, 46.

Mouth to Western Avenue Bridge, 1861, **79**, 290.

By R. A. Shailer, to head of tide water, **79**, 52, 290.

## CHARLESTON, S. C. (See *Dismal Swamp Canal.*)

## CHARLESTON HARBOR, S. C.[a] (See *Chesapeake Bay.*)

**Appropriations.**

| | | |
|---|---|---|
| 1852, | $50,000, | act Aug. 30. |
| 1871, | 13,000, | **71**, 69. |
| 1872, | 38,700, | **72**, 651; **76**, 372. |
| 1873, | 5,000, | **73**, 68. |
| 1874, | 18,000, | **74**, 77. |
| 1875, | 10,000, | **75**, 83. |
| 1876, | 10,000, | **76**, 69. |
| 1878, | 200,000, | **78**, 77, 544. |
| 1879, | 200,000, | **79**, 96. |
| 1880, | 170,000, | **80**, 928. |
| 1880, | [b] 5,000, | **80**, 932. |
| 1881, | 175,000, | **81**, 1053. |
| 1882, | 300,000, | **82**, 1136. |
| 1884, | 250,000, | **84**, 1085. |
| 1886, | 187,500, | **86**, 1073. |
| 1888,[c] | 350,000, | **88**, 975. |
| 1890, | 370,000, | **90**, 1193. |
| 1892, | 225,000, | **92**, 1223. |
| 1893, | 750,000, | **93**, 1504. |
| 1894, | 450,000, | **94**, 1427. |
| 1895, | 500,000, | **95**, 1427. |
| 1899, | 175,000, | **99**, 1543. |
| 1900, | 45,000, | **1900**, 1868. |
| 1900, | 175,000, | **1900**, 1868. |
| Total, | 4,672,200 | |

**Commerce.**

**71**, 584; **78**, 551, 552; **89**, 1155.

Benefited by the work, **71**, 584.

Discussed by the president of the city chamber of commerce, **78**, 551.

Commercial necessity for improvement, **81**, 1052; **87**, 1130, 1137.

From a commercial as well as from a military standpoint the harbor should be accessible to the largest vessels, **99**, 1556.

**Contracts.**

**1871.** B. Maillefert, removing wrecks of 5 vessels, **72**, 651.

**1872.** B. Maillefert, removing monitor *Patapsco* to 25 f. l. w. water, **72**, 652. B. Maillefert, removing three wrecks to 20 f. l. w. water, 1 to 7 f. l. w., **73**, 727. J. Griffin, removing three wrecks and 125 f. of jetty to 20 f. l. w., **73**, 727; **75**, ii, 28; **76**, 430.

**1873.** B. Maillefert, removing monitor *Keokuk* to 15 f. l. w., **73**, 727.

**1874.** B. Maillefert, removing 1,878 c. y. stone from ruined jetty, **75**, ii, 28; **76**, 430.

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[a] Examinations.—Report (favorable), 1852. Report (favorable), June 26, 1854. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Sullivans Island.

[c] From this date Sullivans Island is included.

## CHARLESTON HARBOR, S. C.—Continued.

**1874.** D. Symons, removing 2,500 c. y. stone from ruined jetty, **75**, ii, 28; **76**, 430.

**1878.** Bangs & Dolby, foundation apron for north jetty, **79**, 736.

**1879.** Bangs & Dolbey, jetties, **80**, 928; completed, **81**, 1044.

**1880.** F. P. Murphy, riprap stone, $2.80 per c. y., on north jetty, **81**, 1053; contract annulled, **81**, 1044. N. A. Devereux, laying courses of logs and brush overlaid with 1 f. of riprap stone; price per l. f., $10.73, **81**, 1054; annulled, **82**, 1131. M. Dolbey, work upon jetties, $13.45 per l. f.; completed, **81**, 1054. E. T. Bangs, jetty construction, **81**, 1067.

**1882.** A. A. Howlett, mattress, 72 cents per s. y., and riprap stone, 59 cents per c. y., **83**, 879; extension of contract, **83**, 875; completion, **84**, 1080.

**1884.** A. A. Howlett, construction of jetties, 67 cents per s. y. for mattress, and $3.41 per c. y. for stone, **85**, 1182; contract completed, **86**, 1068. H. H. Penny, dredging between jetties, 30 cents per c. y., **85**, 1182; contract completed, **86**, 1069.

**1886.** A. M. Bangs, mattress, 49 cents per s. y., and stone, $3.09 per c. y., **87**, 1133.

**1889.** C. McK. Grant and J. W. Egan, jetty construction, $213,550, **89**, 1147. B. C. Howell, dredging, 17¼ cents per c. y., **89**, 1147.

**1890.** J. Friday, riprap stone, $1.90 and $2.15 per ton, **91**, 1471.

**1891.** H. W. Crouch, breakwater construction, $4,300, **92**, 1224.

**1892.** Egan & Friday, stone, $2.55 to $3.20 per short ton, in place in the jetties; mattresses at $1.25 per s. y., and dredging at 28 cents per c. y. ($1,884,000), **93**, 1504.

**1897.** Broderick & Ferguson, 1,600 tons steam coal, $2.65 per ton, **97**, 1473.

**1898.** Newport News Shipbuilding & Dry Dock Co., repairs to dredger, $2,476.88, **98**, 1284. New York Belting & Packing Co., rubber suctions, $14.14 per f. ($114.89). Consumers Coal Co., furnishing wharf $30 per month, handling coal 85 cents per ton, storage room free. Valk & Murdock Iron Works, new dredge-pumping engine, $3,600. Hugh Ferguson & Co., schooner load of coal, $2.45 per ton. **99**, 1544.

**1899.** Newport News Shipbuilding & Dry Dock Co., docking, raising hull, and repairing dredge *Charleston*, $32,479.17, **99**, 1544, 1545.

**Engineers.**

CHIEF OF ENGINEERS:

Reports to Secretary of War, concurring in views of Board of Engineers on Lt. Col. Gillmore's project for permanent jetties, **78**, 553.

Reports, **66**, 3; **70**, 31, 63; **71**, 69; **72**, 64; **73**, 68; **74**, 76; **75**, 82; **76**, 69; **77**, 66; **78**, 76; **79**, 95; **80**, 126, 127; **81**, 168, 170; **82**, 164; **83**, 171, 882; **84**, 178; **85**, 177; **86**, 176; **87**, 140; **88**, 134; **89**, 149; **90**, 134; **91**, 175; **92**, 173; **93**, 187; **94**, 172; **95**, 196; **96**, 175; **97**, 222; **98**, 219; **99**, 252, 255; **1900**, 287.

BOARDS OF ENGINEERS:

Convened Apr. 24, 1878, presented preliminary report, concurring in Lt. Col. Gillmore's views as to the practicability of the jetty system, for improvement to a depth of 21 f. at m. l. w. on the bar; cost, $1,800,000 to $3,000,000. Report, **78**, 571. (Col. Tower and Lt. Cols. Wright, Newton, and Gillmore.)

Convened at Washington Nov. 10, 1888, by S. O. No. 50, to examine and report upon Capt. Abbot's revised project for the improvement of Charleston Harbor. Report, **89**, 1150. (Lt. Cols. Gillespie and King and Maj. Post.)

ENGINEERS IN CHARGE:

Maj. Q. A. Gillmore, 1870–87. **70**, 63; **71**, 69:

Instructions to Capt. Ludlow, **71**, 580.

Report and project for permanent jetties, **78**, 554.

Reports, **71**, 578; **72**, 651; **73**, 728; (Lt. Col.) **74**, ii, 3; **75**, ii, 28; **76**, 430; **77**, 369; **78**, 543; **79**, 732; **80**, 921, 931; **81**, 1043, 1064; **82**, 1129; (Col.) **83**, 873; **84**, 1077; **85**, 1172; **86**, 1063; **87**, 1125.

Capt. F. V. Abbot, 1888–97. Reports, **88**, 970; **89**, 1144, 1151, 1153; **90**, 1190; **91**, 1467; **92**, 1219; **93**, 1495; **94**, 1101, **95**, 1421; **96**, 1189, **97**, 1471.

Maj. E. H. Ruffner, 1898–1900. Reports, **98**, 1283; **99**, 1542, 1551; **1900**, 1908.

Capt. J. C. Sanford, 1900–. Report, **1900**, 1867.

ASSISTANTS:

Capt. W. Ludlow, **71**, 69; **73**, 68. Report, **71**, 580.

Eppley and Guerrero, **71**, 584.

Capt. D. P. Heap, **73**, 68; **74**, 76.

Lt. F. A. Mahan, **74**, 76.

Capt. J. W. Cuyler, **74**, 76. Report, **74**, ii, 4.

Capt. J. C. Post, **74**, 76. Reports, **77**, 369; **78**, 546; **79**, 736; **80**, 929; **83**, 880, 883.

G. Daubeney, on current observations, **78**, 544.

Capt. B. D. Greene. Reports, **81**, 1055; **82**, 1136.

Lt. T. N. Bailey. Reports, **83**, 879; **84**, 1085.

Lt. F. V. Abbot. Reports, **85**, 1182; **86**, 1073; **87**, 1133.

## CHARLESTON HARBOR, S. C.—Continued.

J. P. Allen. Reports, **88**, 975; **89**, 1147; **90**, 1193; **91**, 1471; **92**, 1224; **93**, 1504; **94**, 1107; **95**, 1427; **96**, 1199; **97**, 1477; **1900**, 1870, 1909.

E. O. Patterson. Report, **93**, 1508.

**Estimates.** (See *Private work.*)

Capt. Ludlow, 1871. Removing wrecks, 125 f. of jetty, and and dredging Beach Channel, $100,750, **71**, 584. Maj. Gillmore, $75,700, **71**, 69, 70, 579.

Maj. Gillmore, 1873, removing wrecks in Beach Channel and dredging, $13,000, **73**, 731; removing 75 f. of jetty in Beach Channel, $5,000, **73**, 731.

Lt. Col. Gillmore, 1874, removing 50 f. more of jetty in Beach Channel, $10,000, **74**, ii, 5.

Lt. Col. Gillmore, 1875, additional dredging in harbor, $25,000, **75**, ii, 31.

Lt. Col. Gillmore, 1876, additional for removing new shoals, $10,000, **76**, 431.

Lt. Col. Gillmore, 1877, additional for removing jetty, $5,000, **77**, 370.

Lt. Col. Gillmore, 1878, permanent works, low jetties, $1,800,000; permanent works, jetties full height, $4,278,000, **78**, 545, 570.

Original estimate for removing 9 wrecks and 125 f. of jetty stated at $74,000 to $76,000, **73**, 68, 727; **74**, ii, 3; **77**, 370. Exceeded in 1875 by $9,700, **75**, ii, 30; in 1878 by $17,000, **79**, 95.

**Expenditures.**

By State of South Carolina, $200,000. By City of Charleston, $25,000, **78**, 552. By United States, 1871-78, $93,000, **79**, 95; $93,700, **79**, 731. List of expenditures by contractor in removing wreck of monitor *Patapsco*, **73**, 730.

**Legislation.**

Resolution of U. S. Senate, Apr. 25, 1878, calling for information regarding permanent works, **78**, 553.

**Obstructions.**

Bridge across the cove in rear of Sullivans Island partly finished and then abandoned; steps taken by the War Department to have the obstruction removed, in 1894, **94**, 1106.

**Operations.**

Suspended from 1854 to 1870, **66**, 3; **70**, 31, 63.

**1869-71.** Examination and survey made, **70**, 31, 63.

**1871-72.** 5 wrecks removed, **72**, 65.

**1872-73.** 4 wrecks, 613 c. y. stone from jetty, and 150 l. f. jetty removed, **73**, 728.

**1873-74.** 4 wrecks removed; 738 c. y. stone from jetty removed, **74**, ii, 4.

**1874-75.** 1 wreck removed; 3,376 c. y. stone from jetty removed, 1,016 c. y. of which were piled on jetty; pier head built, **75**, ii, 28, 29.

**1875-76.** 2,667 c. y. stone from jetty removed, 9,632 c. y. dredged, **76**, 430.

**1876-77.** 4,800 c. y. stone from jetty, and 185 l. f. jetty removed; 680 c. y. dredged, **76**, 69, 77, 369.

**1877-78.** 200 c. y. stone from jetty, and 30 l. f. jetty removed; a few c. y. dredged; **78**, 543.

**1878-79.** North jetty laid for 4,096 l. f., height 4 to 5 f., under a new project for improving entrance, **79**, 96, 731.

**1879-80.** North and south jetties in progress, **80**, 927.

**1880-81.** 35,789 c. y. of stone deposited in north and south jetties; dredging on bar, **81**, 1044, 1046, 1047. 324 l. f. of log jetty built and covered with 495 c. y. of riprap stone, **81**, 1066.

**1881-82.** North jetty extended 2,319 l. f., south jetty extended 3,209 l. f.; spur jetty built, **82**, 1137; 28,387 c. y. riprap stone deposited upon north jetty, **82**, 1131; 23,030 c. y. riprap stone deposited upon south jetty, **82**, 1132.

**1882-83.** Extension of bottom course of granite jetty 2,657 l. f., and enlarging foundation course of work, **83**, 875; 35,753 c. y. of riprap stone placed in the work, **83**, 876.

**1883-84.** Bottom course of south jetty extended 816 l. f. seaward and 513 l. f. landward; 33,159 s. y. log and brush placed; 17,299 c. y. riprap stone laid over mattresses, **84**, 178; 183 c. y. of riprap stone distributed over portions of second spur jetty, Sullivans Island, **84**, 1081.

**1884-85.** Bottom course of south jetty extended 2,228 l. f.; 69,398 s. y. log and brush mattress overlaid with 25,182 c. y. of riprap stone; 8,929 c. y. dredged between jetties; 952 l. f. of spur dike built, **85**, 178.

**1885-86.** Work continued on north jetty; foundation of south jetty extended seaward 43 f.; ridge of riprap deposited upon existing work; 18,289 s. y. of log and brush mattress and 15,341 c. y. of riprap stone put in the two jetties; 76,620 c. y. dredged between jetties, **86**, 176, 177; the outer end of north jetty, 14,327 f. from Sullivans Island and within 1,200 f. of the outer 18-f. curve; the outer end of south jetty, 16,440 f. from Morris Island and 2,500 f. from outer 18-f. curve, **80**, 176.

**1886-87.** 19,077 s. y. of mattress and 13,277 c. y. of stone added to north jetty; 18,621 s. y. mattress and 9,508 c. y. of stone added to south jetty; no additional extension seaward made. Total material used in the construction of the jetties, 480,814 s. y. of mattress, 250,959 c. y. of stone, **87**, 1128, 1133.

## CHARLESTON HARBOR, S. C.—Continued.

**1887–88.** 7,177 c. y. stone and 926 s. y. log mattress placed in south jetty; 7,613 c. y. stone used on south jetty, **88,** 972.

**1888–89.** 1,921 tons riprap deposited at outer end of south jetty, **89,** 1145.

**1889–90.** 21,353 tons riprap deposited at outer end of north jetty, and 34,012 tons upon south jetty; 56,626 c. y. dredged, **90,** 1190.

**1890–91.** 43,264 tons stone deposited on the south jetty and in the main ship channel; 47,626 c. y. dredged from the main ship channel, **91,** 1468.

**1891–92.** 19,284 tons stone deposited in south jetty under contract, and 52,439 tons by hired labor; 32,966 tons stone deposited in north jetty under contract, and 1,202 tons by hired labor, **92,** 1224.

**1892–93.** 105,278 tons of stone placed in north jetty, 54,278 tons in the south jetty, and 269,070 c. y. dredged, **93,** 1504.

**1893–94.** 49,403 tons of stone were placed in the north jetty and also 4,479 s. y. mattresses; 164,829 tons of stone were placed in the south jetty and also 23,285 s. y. mattresses; 503,055 c. y. were dredged, **94,** 1107, 1108.

**1894–95.** 53,073 tons of stone and 6,142 s. y. mattresses were placed in the north jetty and 93,251 tons of stone in the south jetty; 592,562 c. y. were dredged, **95,** 1427, 1428.

**1895–96.** 465 tons of stone were placed in the north jetty and 4,142 tons in the south jetty; 493,735 c. y. were dredged, **96,** 1200.

**1896–97.** 2,316 tons of large stone were placed in the north jetty, dredger was repaired, and 385,882 c. y. dredged, **97,** 1478.

**1897–98.** 9,378 short tons of stone were placed in the north jetty, dredger was repaired, and 390,270 c. y. were dredged, **98,** 1283.

**1898–99.** 271,000 c. y. dredged, **99,** 1542.

**1899–1900.** 253,400 c. y. dredged, **1900,** 1867.

**Physical characteristics.**

Of harbor described, with list of wrecks forming obstructions to navigation, **71,** 581.

Current observations, Beach Channel, **76,** 431; North Channel, **78,** 544; **79,** 731.

Borings, Charleston Bar, **78,** 543, 546; **79,** 96, 731.

Of Beach Channel, **74,** ii, 4; **76,** 431; **78,** 546, 550.

Channels and bar, **78,** 544; described and discussed by Lt. Col. Gillmore, **78,** 555.

Table of mean low-water depths in channels, 1821 to 1877, **78,** 557.

Capacity of tidal basin, **78,** 557.

Reference made to report of commission, headed by Prof. Bache, U. S. C. S., rendered in 1852, **71,** 583; **78,** 555.

Marls from borings, **79,** 737; analysis of same, **79,** 739.

Description of, **93,** 1502; **94,** 1105, 1109; **95,** 1423, 1429; **96,** 1200; **97,** 1478; **98,** 1823; **99,** 1552; **1900,** 1871.

Current measurements, **93,** 1506.

Barometer readings and wind velocities, **94,** 1103.

Tidal observations, **94,** 1103, 1104, 1109; **95,** 1425, 1429; **96,** 1200; **97,** 1478.

Description of Charleston Harbor to Alligator Creek, **1900,** 1910.

**Private (City and State) work.**
(See *Estimates.*)

City authorities contracted with B. Maillefert to dredge main ship (Pumpkin Hill) channel to 20 f. at m. h. w., or 15 f. at m. l. w., **74,** ii, 5; **75,** ii, 29. Report on this channel, comparing it with Beach Channel, **75,** ii, 30. No perceptible improvoment after a year's work, **76,** 430.

By State and City, **78,** 552.

**Projects.**

By Capt. Ludlow and Maj. Gillmore, in 1870, removing wrecks, 125 l. f. of Bowman's jetty, and dredging Beach Channel, **72,** 652; **75,** 579. Modifications of this project, **74,** 76, ii, 3, 4, 5; **75,** 82, ii, 29; **77,** 67.

By Lt. Col. Gillmore, 1878, establishing and permanently maintaining a practicable channel across the bar of not less than 21 f. depth at m. l. w., with two converging jetties of random stone on brush and log mattresses, an opening between the ends of the jetties of about 2,900 f.; estimate, $3,000,000, **78,** 558, 572; **86,** 176; **87,** 1135.

Lt. Col. Gillmore, 1880, for protection of south shore of Sullivans Island with 3 log and riprap spur jetties, 150 to 180 f. in length, at right angles to the shore line. Estimate, $6,000. **80,** 931.

In 1889 it was estimated that to bring the jetties to low-water level throughout would require $2,548,000 in addition to prior appropriations, making the total estimated cost of the jetties, if left at m. l. w. level throughout, $4,380,500, **89,** 1144; **90,** 1190; **91,** 1470; **92,** 1220.

Government dredging discontinued and the work ordered to be done by continuing contract by act of July 13, 1892, **93,** 1495.

In response to a resolution passed by Congress, 1898, Maj. Ruffner estimated the total cost of a channel 26 f. deep m. l. w. from Charleston Harbor to the ocean would be $2,408,552, **99,** 1555.

Maj. Ruffner estimated, 1899, it would cost $281,600 for a 6 f. channel 75 f. wide at bottom between Charleston Harbor and Alligator Creek, **1900,** 1909.

## CHARLESTON HARBOR, S. C.—Continued.

**Surveys.**

Examination or survey commenced, **70**, 63; for which $3,000 was allotted, **71**, 580.

Survey of Beach Channel, **78**, 543, 547.

Field work and survey of outer and inner harbors and the bar, **82**, 1130.

General survey of outer harbor, including the bar and its exterior slope, commenced, **83**, 875; completed, **84**, 1085.

Examination into condition of north and south jetties, **84**, 1081, 1088.

Resurvey of area between sea and portions of jetties, **85**, 1177; **86**, 1076; **87**, 1132.

Surveys made from 1893 to 1898, **93**, 1502; **94**, 1109; **95**, 1425, 1428; **96**, 1200; **97**, 1478; **98**, 1283; **99**, 1543.

Examination and survey of waterway between Charleston Harbor and Alligator Creek, S. C., with view to ascertain cost of improvement, ordered by act of Mar. 3, 1899; examination, only considered necessary; made, 1899, under direction of Maj. Ruffner (report favorable) (see *Projects*), **1900**, 1908.

MAPS.

Sketch, approaches to Charleston Harbor, **66**.

Plan and sections of bar, **78**, 570.

Two maps showing site and section of the north jetty, **79**, 734.

Sketch showing mattress used in the north jetty, **79**, 736.

**80**, 926; **81**, 1052; **82**, 1136; **83**, 878; **84**, 1088; **85**, 1180; **86**, 1076; **87**, 1132; **88**, 934; **89**, 1146; **90**, 1192; **91**, 1470; **92**, Atlas, 45, 46, 47; **93**, 1504; **94**, 1110; **95**, 1432; **96**, 1204; **97**, 1478; **98**, 1284; **99**, 1546; **1900**, 1870.

## CHARLESTON TO CHESAPEAKE BAY. (See *Pasquotank River, N. C.*)

## CHARLESTON NECK, S. C., SHIP CANAL ACROSS.

**Commerce.**

Benefits to, from construction of canal, **81**, 1165.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 132; **81**, 179.

ENGINEER IN CHARGE. Lt. Col. Q. A. Gillmore, 1880. Report, **81**, 1164.

**Physical characteristics.**

Charleston Neck and its surroundings, **81**, 1165.

**Plans.**

By Capt. Post, for canal of 20 f. depth at mean low water, bottom width of 200 f., with tide gates at each end. Estimate, $439,789. **81**, 1167.

**Private (State) work.**

Appropriation of $15,000 by South Carolina toward construction of canal, **81**, 1167.

**Surveys.**

Ordered by act of June 18, 1878; made, 1880, under the direction of Lt. Col. Gillmore, 1880, **80**, 132.

Location selected for ship channel, **81**, 1165.

## CHARLEVOIX HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1876, | $10,000, | **77**, 105. |
| 1878, | 12,000, | **78**, 120, 1200. |
| 1879, | 9,000, | **79**, 161, 1600. |
| 1880, | 10,000, | **80**, 2009. |
| 1881, | 10,000, | **81**, 2198. |
| 1882, | 10,000, | **82**, 2282. |
| 1884, | 10,000, | **84**, 1972. |
| 1886, | 10,000, | **86**, 1756. |
| 1888, | 12,500, | **88**, 1901. |
| 1889, | 9,000, | **90**, 2611. |
| 1892. | 10,000, | **92**, 2317. |
| 1894, | 8,000, | **95**, 2817. |
| 1896, | 20,000, | **96**, 2717. |
| 1899, | 15,000, | **99**, 2948. |
| Total, | 155,500 | |

**Commerce.**

Harbor a harbor of refuge, **69**, 29, 78; **73**, 283; **76**, ii, 522.

Importance, **69**, 79; **73**, 282, 283.

**Contracts.**

**1877.** Carkin & Stickney, materials and labor, **77**, 901, 902.

**1878.** Carkin & Stickney, pier extension, **79**, 1598. Hervey S. Dale, pier extension, **79**, 1597, 1600.

**1880.** N. G. Dodge, dredging, 14 cents per c. y., **81**, 2199.

**1881.** C. Sutherland, pier construction, **81**, 2198.

**1882.** L. E. Allen, pier construction, **83**, 1807.

**1886.** L. E. Allen, dredging and pier construction, **87**, 2178.

**1889.** G. W. Crouter, pier constructions, $8,595.30, **89**, 2166.

**1891.** Gaylord & Wing, piles, 10 cents per l. f., and white-pine timber, $18 per M f. b. m. G. W. Crouter, bolts, 3 cents per pound. Truman & Cooper, brush, $6 per cord. F. A. Hagen, stone, $2.24 per cord, **91**, 2673.

## CHARLEVOIX HARBOR, MICH.—Continued.

**1896.** W. A. Starke, dredging, **96,** 2716.

**1897.** J. A. Beauvais, reconstruction of pier, $4,031.90, **97,** 2943.

**1898.** R. B. Rice, pier repair, $5,748.55, **98,** 2534.

**1899.** Greens Dredging Co., dredging, **99,** 2948.

**1900.** Green & Anderson, pier repairs (removing old work, piles, ironwork), $6,606.25, **1900,** 3931.

**Documents.** (Not published in reports.)

Ex. Doc. No. 164, 43d Cong., 2d sess., mentioned, **76,** ii, 522.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **69,** 29; **73,** 40; **76,** 103; **77,** 105; **78,** 119; **79,** 161; **80,** 214; **81,** 289; **82,** 284; **83,** 292; **84,** 293; **85,** 315; **86,** 309; **87,** 277; **88,** 251; **89,** 294; **90,** 264; **91,** 336; **92,** 2315; **93,** 378; **94,** 352; **95,** 387; **96,** 343; **97,** 433, 435; **98,** 422; **99,** 503; **1900,** 566.

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1869. Report, **69,** 78.

Maj. S. M. Mansfield, 1873–80. Reports, **73,** 281; **76,** ii, 522; **77,** 901; **78,** 1199; **79,** 1597; **80,** 214.

Maj. F. Harwood, 1880–82. Reports, **80,** 2007; **81,** 2197.

Maj. D. P. Heap, 1882–83. Report, **83,** 2281.

Capt. D. W. Lockwood, 1883–87. Reports, **83,** 1805; **84,** 1971; **85,** 2065; **86,** 1755; **87,** 2176.

Maj. S. M. Mansfield, 1888–89. Report, **88,** 1899.

Maj. W. Ludlow, 1889–93. Reports, **89,** 2164; **90,** 2610; **91,** 2672; **92,** 2315; **93,** 2908.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94,** 2233; **95,** 2816; **96,** 2715; **98,** 2532.

Capt. C. McD. Townsend, 1897. Reports, **97,** 2942, 2953.

Capt. C. Harding, 1899–. Reports, **99,** 2946; **1900,** 3928.

ASSISTANTS:

W. T. Casgrain. Report, **69,** 78.

C. M. Wells. Report, **73,** 284.

J. C. Nettleton, **73,** 285.

F. W. Lehnartz. Report, **1900,** 3929.

**Estimates.** (See *Plans* and *Projects.*)

By W. T. Casgrain, $198,044.14, **69,** 78, 82.

By Capt. Mansfield, 1873, $192,780, **73,** 283. In 1875–76, $186,000; $91,303.50, **76,** ii, 523.

**Legislation.**

Sixteen sections of land granted by Michigan in aid of the improvement, **73,** 282.

**Operations.**

**1872–73.** Crib pier, north side 460 f. long, south side 80 f. long, built by the people of Charlevoix; superstructure built by the State. Dredging 14,000 c. y., **73,** 282, 285.

**1877–78.** South pier extended 190 f.; 159 f. of brush work; old pier partially refilled with stone; dredging 23,436 c. y., **78,** 119, 1199, 1200.

**1878–79.** North pier extended 150 f., south pier 100 f.; old pier reballasted, **79,** 161, 1597. History of operations, **79,** 1598. Crib work compared with pile work, **73,** 287; **76,** ii, 522. Method of constructing proposed pile work, **73,** 284.

**1879–80.** 5,083 c. y. dredged, 150 l. f. of north pier extension nearly finished; **80,** 2007.

**1880–81.** 165 l. f. pile revetment repaired, superstructure over north pier nearly completed, 8,203 c. y. sand dredged from channel, **81,** 2197.

**1881–82.** 27,062 c. y. removed from channel, **82,** 2281. 1,401 l. f. plank-beam revetment and 440 l. f. close-pile revetment constructed; minor repairs to crib work, **83,** 2282.

**1882–83.** 10,306 c. y. dredged from channel, **83,** 1806.

**1883–84.** Backing placed behind revetments, **84,** 1972.

**1884–85.** 161 f. plank-beam revetment repaired, 75 l. f. plank-beam revetment changed to close piling, channel face of south pier built up, 210 cords brush and 674 cords stone used in backing plank-beam revetment, **85,** 2066.

**1885–86.** 330 l. f. of superstructure completed, **86,** 1756.

**1886–87.** 3,360 c. y. gravel dredged from lower channel, **87,** 2176.

**1887–88.** 354 l. f. of plank-beam revetment placed in north side of channel; 45,000 c. y. dredged from between the piers; south pier extended 50 f., **88,** 1900.

**1888–89.** Three cribs built and repairs made to end of north pier by contract; 2,500 c. y. dredged by hired labor, **89,** 2164.

**1889–90.** 5,760 c. y. dredged by hired labor, **90,** 2610.

**1890–91.** 33,500 c. y. dredged, and repairs made to upper channel revetments, **91,** 2672.

**1891–92.** Repairs to revetment in lower channel, and gap between north pier and revetment at shore line filled with brush and stone, **92,** 2316.

**1892–93.** 14,105 c. y. dredged and gauge readings made, **93,** 2908, 2909.

**1893–94.** Repairs made to piers and revetments, and 16,945 c. y. dredged, **94,** 2234.

**1895–96.** 35,348 c. y. dredged, **96,** 2716.

## CHARLEVOIX HARBOR, MICH.—Continued.

**1896–97.** Rebuilding of north pier in progress, **97,** 2943.

**1897–98.** Rebuilding of north pier completed, the total amount of stone placed being 1,036 cords, and repairs to 723 l. f. of the south revetment of the lower channel in progress, **98,** 2533.

**1898–99.** South pier repairs completed, **99,** 2946.

**1899–1900.** 11,673 c. y. dredged, about 168 f. of revetment repaired, and about 400 f. more revetment under repair, **1900,** 3929.

**Physical characteristics.**

Charlevoix Harbor and vicinity, **69,** 78; **73,** 281.

Natural advantages of harbor, **73,** 284.

Description of drainage area, **89,** 2165.

Soundings, **73,** 281, 282; **79,** 1599, 1600.

**Plans.** (See *Estimates* and *Projects.*)

By W. T. Casgrain, 1868, two parallel crib piers 100 f. apart to 14 f. of water, each 672 f. long; also to connect east end of the south pier with base of sand hills by crib-work, 160 f.; dredging in channel to 12 f. of water, 2,466 l. f. of revetment; estimate, $198,044.14, **69,** 80, 81, 82.

By Capt. Mansfield, 1873, crib pier extension; north pier 500 l. f., south pier if necessary, channel widened to 150 f.; estimate, $192,780, **73,** 282, 284.

By C. M. Webb, 1873, pier extension: north pier 450 l. f., by pilework, south pier 575 f., 50 f. crib pierhead for both piers; completion of crib work on north side now partly built; pile revetment and dredging, **73,** 284, 285.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Mansfield, 1868, dredging a channel 100 f. wide to a depth of 12 f., both sides to be protected by close piling; modified in 1876 by the substitution of crib for pile piers, estimate, $186,000, **69,** 80, 81, 82; **80,** 214; **87,** 2177.

By Maj. Mansfield, 1875–76, pier extension, by crib work, on north side, 925 l. f. to 20 f. of water, south pier 625 l. f. to 12 f. of water, 2,550 l. f. of pile revetment, and dredging in channel to a depth of 12 f.; also removal of old north pier; estimate, $186,000, **76,** ii, 523. Modification of above to meet present requirements; north pier to 12 f. of water, 600 l. f., south pier 550 l. f., removal of old north pier, and dredging; estimate, $91,303.50, **76,** ii, 523.

In 1896 Capt. Townsend estimated it would cost $160,000 to obtain a depth of 16 feet in the harbor, **97,** 2953.

**Private (State and corporate) work.** (See *Legislation.*)

$2,000 expended in construction of a pile pier in 1865, extending 900 f. into the lake to a depth of 20 f. of water, ample accommodation for shipping interests.

Attempt to open a cut across sand beach; work abandoned as too expensive, **69,** 79, 80.

Cut made, crib piers built, dredging to 11 f. of water in river, **73,** 282.

**Surveys.**

By W. T. Casgrain, 1868. Report, **69,** 78.

Examination under direction of Maj. Mansfield, **73,** 40, 281.

Of upper and lower channels, 1883, **83,** 1806.

Survey with a view to obtaining a depth of 16 f. ordered by act of June 3, 1896, made, 1896, by Capt. Townsend (report favorable). (See *Projects*), **97,** 2953.

Maps. **82,** 2282; **83,** 1806.

## CHARLOTTE HARBOR, FLA. (Inside Passage to, from Puntarasa).

**Commerce.**

Increasing in 1896; $154,500 annually, **97,** 1573.

Description of, **1900,** 2042.

**Engineers.**

Chief of Engineers. Reports, **97,** 252, **99,** 288, **1900,** 327.

Engineers in charge:

Lt. Col. W. H. H. Benyaurd, 1897. Report, **97,** 1572.

Capt. H. Jervey, 1900. Reports, **1900,** 2041, 2043.

Assistants:

Lt. J. J. Meyler. Report, **97,** 1573.

W. H. Caldwell. Report, **1900,** 2046.

**Physical characteristics.**

Description of, **97,** 1573; **1900,** 2041.

The passage known as Pine Island Harbor, is part of the direct water route from the Caloosahatchee River to Charlotte Harbor, or by way of Boca Grande Pass to more northern Gulf points, **97,** 1572.

**Projects.**

Capt. Jervey estimated, 1899, it would cost $6,000 for an 8-f. channel, bottom width 100 f., through obstructive shoals northeast of Patricio Island and northeast of Blind Pass, **1900,** 2045.

**Surveys.**

Examination ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd, 1896 (report favorable), **97,** 1572.

Examination and survey ordered by act of Mar. 3, 1899, made, 1899, under direction of Capt. Jervey (report favorable; see *Projects*), **1900,** 2041, 2043.

### CHARLOTTE HARBOR, FLA. (Waterway from, to St. Johns River).

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 132; **81**, 179; **82**, 175.
ENGINEER IN CHARGE. Lt. Col. Q. A. Gillmore, 1880–82. Report, **82**, 1204.
ASSISTANT. W. G. Williamson. Report, **82**, 1219.

**Plan.**
By Lt. Col. Gillmore, 1882, opening steamboat communication from St. Johns River, Fla., by way of Tohopokeliga Lake, to Charlotte Harbor or Pease Creek; estimate, $5,662,812, **82**, 1216.

**Survey.**
Ordered by act of June 14, 1880, **80**, 132; made under direction of Lt. Col. Gillmore, 1882, **82**, 1204.

### CHARLOTTE HARBOR AND PEACE CREEK, FLA. (See *Puntarasa* and *St. Johns River.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1890, | $35,000, | **91**, | 1648. |
| 1894, | 20,000, | **95**, | 1552. |
| 1896, | 20,000, | **96**, | 1330. |
| 1899, | 25,000, | **99**, | 1627. |
| Total, | 100,000 | | |

**Commerce.**
Requirements of **80**, 1100; **85**, 1286.
Commercial interests, **91**, 1682; **1900**, 2050.

**Contracts.**
**1891.** Alabama Dredging & Jetty Co., dredging, 25 cents per c. y., **91**, 1647.
**1894.** J. A. Bryan, dredging, 24 cents per c. y. ($16,800), **95**, 1553.
**1897.** J. A. Bryan, dredging, 29 cents per c. y., **97**, 1559.
**1899.** Stewart Contracting Co., and National Dredging Co., 19 cents per c. y. ($23,750), **99**, 1628, **1900**, 2017.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 140; **85**, 199; **87**, 162; **91**, 190, 196; **92**, 187; **93**, 206; **94**, 191; **95**, 216; **96**, 194; **97**, 246; **98**, 240; **99**, 279, 288; **1900**, 317, 327.
ENGINEERS IN CHARGE:
Capt. A. N. Damrell. Report, **80**, 1100.
Capt. W. T. Rossell. Report, **85**, 1286.
Lt. W. M. Black, 1887–92. Reports, **87**, 1258; (Capt.), **91**, 1646, 1681, 1683, 1684.
Maj. J. C. Mallery, 1892. Report, **92**, 1379.
Lt. A. M. D'Armit, 1893. Report, **93**, 1663.
Maj. T. H. Handbury, 1894–95. Reports, **94**, 1236; **95**, 1551.
Lt. Col. W. H. H. Benyaurd, 1896–98. Reports, **96**, 1329; **97**, 1559; **98**, 1335.
Capt. H. Jervey, 1899. Reports, **99**, 1626; **1900**, 2048, 2053.
Capt. T. H. Rees, 1900–. Report, **1900**, 2017.
ASSISTANTS:
J. L. Meigs. Report, **80**, 1101.
J. H. Bacon. Report, **91**, 1648.
Lt. J. J. Meyler. Report, **97**, 1573.
Lt. F. C. Boggs. Report, **1900**, 2052.

**Operations.**
**1890–91.** Excavation of channel, **91**, 1647.
**1892–93.** 141,293 c. y. dredged, **93**, 1664.
**1894–95.** 20,553 c. y. dredged, **95**, 1552.
**1895–96.** 49,167 c. y. dredged, **96**, 1329.
**1896–97.** 15,173 c. y. dredged, **97**, 1559.
**1897–98.** 43,427 c. y. dredged, **98**, 1335.
**1899–1900.** 125,182 c. y. dredged, **1900**, 2017.

**Physical characteristics.**
Description of, **91**, 1646; **1900**, 2053.

**Plans.** (See *Project.*)
In 1880 Capt. Damrell reported that Charlotte Harbor did not require improvement; that to improve Peace Creek from its mouth to Fort Meade would cost $17,000, **80**, 1100.
In 1884 Capt. Rossell reported that there was no present need for the improvement of Charlotte Harbor, **85**, 1286.
In 1887 Lt. Black did not consider the harbor worthy of improvement, **87**, 1258.

**Projects.** (See *Plans.*)
By Capt. Black, 1891, 12-f. channel, from 50 to 60 f. wide, across all the shoals between Boca Grande and Punta Gorda; estimate, $35,000, **91**, 1684.
By Maj. Handbury, 1895, expenditure of the appropriation of 1894 in dredging on the shoals near Cape Haze, and from thence outward toward Boca Grande Pass, **95**, 1552.
By Lt. Col. Benyaurd, 1896, expenditure of the appropriation of 1896, in improving the channel over Cape Haze shoal, and for widening the channel leading to the wharves previously dredged, **96**, 1330.
Capt. Jervey estimated, 1899, it would cost $140,000 for a 24-f. channel 300 f. wide across the bar at the entrance of the harbor, with $1,000 annually for maintenance, **1900**, 2054.

## CHARLOTTE HARBOR AND PEACE CREEK, FLA.—Continued.

**Surveys.** (See *Plans.*)

Ordered by act of Mar. 3, 1879, **80,** 140; made under the direction of Capt. Damrell, **80,** 1100; by act of July 5, 1884, by Capt. Rossell, **85,** 1286; by act of Aug. 5, 1886, by Lt. Black, **87,** 1258.

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Black, **91,** 1684.

Survey of the shoal north of Cape Haze to determine the best location on which to develop a 12-f. channel made by Maj. Handbury, 1894, **94,** 1236.

Examination, plan, and estimate for improvement of Boca Grande and Charlotte harbor with view to obtaining a depth of 24 f. of water over the bar at the entrance of the harbor and 18 f. thence up to Punta Gorda ordered by act of Mar. 3, 1899, made, 1899, under direction of Capt. Jervey (report favorable) (see *Projects*), **1900,** 2049, 2053.

MAPS.

**91,** 1650, 1685.

## CHARLOTTE HARBOR, MOUTH OF GENESEE RIVER, N. Y.[a]

(See *Genesee River.*)

**Appropriations.**[b]

| | |
|---|---|
| 1828, | $300.00 (survey), act May 23. |
| 1829, | 10,000.00, **66,** iii, 30. |
| 1830, | 13,335.00, **66,** iii, 30. |
| 1831, | 16,670.00, **66,** iii, 30. |
| 1832, | 16,000.00, **66,** iii, 30. |
| 1833, | 15,000.00, **66,** iii, 30. |
| 1834, | 20,000.00, **66,** iii, 30. |
| 1835, | 2,390.00, **66,** iii, 30. |
| 1836, | 20,000.00, **66,** iii, 30. |
| 1837, | 10,000.00, **66,** iii, 30. |
| 1838, | 25,000.00, **66,** iii, 30. |
| 1844, | 10,000.00, **66,** iii, 30. |
| 1852, | 20,000.00, **66,** iii, 30. |
| 1853, | 176.10, **66,** iii, 30. |
| 1864, | 25,000.00 (allotted), **66,** iii, 30. |
| 1866, | 75,607.30, **66,** iii, 30. |
| 1868, | 1,100.00 (allotted), **69,** 22; act July 25. |
| 1969, | 1,000.00 (allotted), **69,** 23; act Apr. 10. |
| 1870, | 12,000.00, **70,** 53. |
| 1871, | 10,000.00, **71,** 50. |
| 1875, | 5,000.00, **75,** 59. |
| 1878, | 1,000.00, **78,** 132. |
| 1879, | 1,000.00, **79,** 175. |
| 1880, | 5,000.00, **80,** 2207. |
| 1881, | 2,500.00, **81,** 2437. |
| 1882, | 35,000.00, **82,** 2445. |
| 1884, | 20,000.00, **84,** 2137. |
| 1886, | 26,250.00, **86,** 1888. |
| 1888, | 45,000.00, **88,** 2072. |
| 1890, | 25,000.00, **90,** 2852. |
| 1892, | 25,000.00, **92,** 2556. |
| 1894, | 15,000.00, **95,** 3186. |
| 1896, | 12,000.00, **96,** 3136. |
| 1899, | 7,000.00, **99,** 3131. |

Total, 528,328.40

**Commerce.**

Important, **66,** iii, 30; **67,** 241; **68,** 249.

Charlotte, the port of entry for Rochester, **69,** 179.

Total value of the freight, 1896, estimated at $1,570,000; 58,235 passengers were carried, **96,** 3136.

Chiefly in coal, 1899, **99,** 3131.

**Contracts.**

**1866.** R. Allen, materials, **66,** iv, 166. Syracuse Iron Works, materials, **66,** iv, 166. Thomas Parsons, materials, **66,** iv, 166.

**1867.** T. Parsons, materials, **67,** 243. W. Burke & Co., materials, **67,** 243. Jennings & Hart, labor, **67,** 243. R. Gorsline, labor, **67,** 243.

**1872.** J. McLean, materials and labor, **72,** 253.

**1875.** Hunter & Cunningham, materials and labor, **75,** 331.

**1882.** A. J. Packard, iron for pier extension, **83,** 1943. J. W. Dennis, labor and materials (except iron) for 600 l. f. of extension, **83,** 1942; completed, **84,** 2137.

**1884.** J. B. Donnelly, 350 l. f. of pier extension, **85,** 2271; extended, **85,** 2272; completed, **86,** 1887.

**Engineers.**

CHIEF OF ENGINEERS:

Transmits estimates for the depening of lake harbors, **67,** 252.

Reports, **66,** 4; ii, 39, 41; iii, 16, 30; **67,** 32; **68,** 45; **69,** 40; **70,** 52; **71,** 50; **72,** 46; **73,** 47; **74,** 54; **75,** 58; **76,** 110; **77,** 117; **78,** 132; **79,** 175; **80,** 231; **81,** 317; **82,** 311; **83,** 319; **84,** 323; **85,** 348; **86,** 342; **87,** 308; **88,** 282; **89,** 333; **90,** 302; **91,** 378; **92,** 357; **93,** 409; **94,** 384; **95,** 418; **96,** 376; **97,** 474; **98,** 463; **99,** 544; **1900,** 612.

ENGINEERS IN CHARGE:

Capt. T. W. Maurice, 1828; **74,** 247.

Capt. A. Canfield, 1842; **74,** 248; **76,** ii, 584.

Maj. W. Turnbull, 1853–56. S. Doc. 42, 35th Cong., 1st sess., pp. 3, 22, 138.

Maj. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess., p. 138.

Capt. J. A. Tardy, 1865–67; **66,** 4; ii, 41; iii, 15. Reports, **66,** 51; iv, 161, 164.

Lt. Col. C. E. Blunt, 1867–69; **67,** 32. Reports, **67,** 240, 243, 245; **68,** 249.

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[a] Survey.—Report, Jan. 22, 1829; estimate, $53,919.16. (H. Doc. No. 428, 55th Cong., 2d sess.)

[b] Total to and including 1875, according to reports, $308,578.40. According to H. Doc. 120, 44th Cong., 1st sess., $307,178.40.

## CHARLOTTE HARBOR, MOUTH OF GENESEE RIVER, N. Y.—Continued.

Maj. M. D. McAlester, 1869; **69**, 170; **76**, ii, 584.

Maj. F. Harwood, 1869; **69**, 170; **76**, ii, 585.

Maj. N. Bowen, 1869–71; **69**, 170. Reports, **69**, 178; **70**, 202; **71**, 228.

Maj. J. M. Wilson, 1871–76. Reports, **72**, 252; **73**, 359; **74**, 247; **75**, 330.

Maj. W. McFarland, 1876–83. Reports, **76**, ii, 582; **77**, 978; **78**, 1273; **79**, 1727; **80**, 2207; **81**, 2436; **82**, 2444.

Lt. Col. H. M. Robert, 1883–85. Reports, **83**, 1942; **84**, 2137.

Capt. E. Maguire, 1885–86. Reports, **85**, 2271; **86**, 1887.

Capt. C. F. Palfrey, 1886–90. Reports, **87**, 2371; **88**, 2069; **89**, 2407.

Maj. M. B. Adams, 1890–91. Reports, **90**, 2849, 2854.

Capt. D. C. Kingman, 1891–95. Reports, **91**, 2899; **92**, 2551; **93**, 3132; **94**, 2455; **95**, 3183.

Maj. W. S. Stanton, 1896–98. Reports, **96**, 3131; **97**, 3269, **98**, 2799.

Capt. G. D. Fitch, 1899. Reports, **99**, 3130; **1900**, 4163.

**Estimates.** (See also *Projects.*)

By Maj. Turnbull, 1853, repairs, $24,000, **76**, ii, 584.

By Lt. Col. Blunt, deepening harbor to 14 f. at mouth of Genesee River, $25,000, **67**, 252.

By Maj. McFarland, rebuilding superstructure of piers, $45,000, **79**, 1728. Excess of appropriations over estimates accounted for, **74**, 249.

**Operations.** [a]

**1829–33.** Construction of east and west piers 2,407 f. and 2,305 f. in length, respectively, **74**, 247.

**1833–34.** Piers extended to length of 2,876 f. each, **74**, 247.

**1842.** 60 f. of both piers carried away, **74**, 248.

**1852-53.** Repairs; condition of piers. S. Doc. 42, 35th Cong., 1st sess., p. 138.

**1857.** East pier is 2,034 f. long, west pier 1,943 f. long. S. Doc. 42, 35th Cong., 1st sess., p. 138.

**1864–65.** Repairs, east pier 2,400 f. long; condition of piers, **66**, 51.

**1865–67.** Repairs to west pier, **66**, ii, 39, iv, 161; **67**, 32, 240.

**1867–69.** Repairs in general, **68**, 45, 249; **69**, 40, 179.

**1869–70.** Repairs completed; east pier 2,345 f. long, west pier 2,454 f. long, **70**, 52, 202.

**1870–71.** Superstructure raised; 2 cribs (60 f.) sunk in extension of east pier, **71**, 50, 228.

**1871–77.** Repairs; east pier 2,450 f. long and west pier 2,700 f. long, **72**, 46, 253; **73**, 47, 259; **74**, 54; **75**, 58, 330; **76**, 110; ii, 582; **77**, 117, 978.

**1878–79.** Repairs; east pier 2,425 f. long, **79**, 175, 1727.

Injuries to piers by collisions and gales, **75**, 331.

**1879–80.** Repairs to east and west piers, **80**, 2207.

**1880–81.** Repairs to west pier; 707 f. of superstructure of east pier rebuilt, **81**, 2436.

**1881–82.** 43 f. of east pier superstructure rebuilt, **82**, 2444.

**1883–84.** 16 cribs (30 f. in length) placed in east and west piers and 600 l. f. superstructure built over same, **84**, 2137.

**1884–85.** One and one-half cribs framed, **85**, 2272.

**1885–86.** 350 l. f. of pier extension completed, **86**, 1887.

**1886–87.** 800 l. f. superstructure east pier built, **87**, 2372.

**1887–88.** 1,400 l. f. of west pier superstructure rebuilt; breaches in west pier repaired; pocket in east pier reballasted; 156 detached piles removed; work done by hired labor, **88**, 2070.

**1888-89.** 20,000 c. y. dredged; repairs to east and west piers, **89**, 2409.

**1889–90.** 98,377 c. y. dredged, **90**, 2851.

**1890–91.** Superstructure of Section E of east jetty rebuilt for a distance of 995 l. f.; repairs to outer end of east pier; 18,680 c. y. dredged from the channel, **91**, 2901.

**1891–92.** 83,513 c. y. dredged; west jetty superstructure renewed; repairs to superstructure on east and west jetties, **92**, 2555.

**1892–93.** 54,960 c. y. dredged; and extension of west jetty in progress, **93**, 3134.

**1893–94.** In connection with previous year the west jetty was extended 365 f., **94**, 2458.

**1894–95.** 67,650 c. y. dredged, **95**, 3186.

**1895–96**[a]. East pier extended 121 f., **96**, 3135; 1,920 c. y. dredged and repairs made to piers, **96**, 3135.

**1896–97.** Over 18,840 c. y. dredged and west pier repaired, **97**, 3270.

**1897–98.** 49,973 c. y., s. m., dredged, **98**, 2799; and minor repairs made to the jetties, **98**, 2800.

**1898–99.** Repair and fitting out of dredging plant, **99**, 3131.

**1899–1900.** 53,865 c. y. dredged, east and west piers repaired, **1900**, 4163.

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[a] History of operations from 1829, **96**, 3131.

## CHARLOTTE HARBOR, MOUTH OF GENESEE RIVER, N. Y.—Continued.

**Physical characteristics.**

Shoal off outer end of east pier, **73**, 359.

Effect of pier extension upon depth of channel, **74**, 247; **76**, ii, 583.

Advance of shore line, **76**, ii, 585.

Description of, **74**, 247; **88**, 2072; **96**, 3134; **97**, 3270.

Good harbor of refuge near the middle of the American shore of the lake and about midway between the Niagara and St. Lawrence rivers, **97**, 3271.

The sediment deposited by freshets of the Genesee River, on which the harbor is situated, necessitates more or less dredging annually to maintain the depth of 16 f. in the channel, **98**, 2800.

**Projects.** (See *Estimates.*)

By Capt. T. W. Maurice, 1829, construction of parallel piers, **74**, 247.

For masonry superstructure, 1836, to supersede wooden one; ultimately abandoned, **74**, 247.

By Maj. J. D. Graham, 1857, general rebuilding of eastern pier; estimate, $41,084.34. S. Doc. 42, 35th Cong., 1st sess., p. 138.

By Capt. J. A. Tardy, 1865, repairs and dredging; estimate, $75,607.30; increased by Lt. Col. Blunt to $85,607.30, **66**, 4, 51; **67**, 33.

By Maj. N. Bowen, extension of east pier; estimate, $45,000, **69**, 40, 179; **70**, 203.

By Maj. J. M. Wilson, repairs to cost $5,000, **74**, 249; **75**, 59.

By Maj. W. McFarland, annual repairs to piers, $1,000, **76**, ii, 582.

The projects of 1829–80, modified, 1881, by Maj. McFarland, to provide for an extension of the piers to the 15-f. curve in the lake, with the formation, by dredging, of a channel between the piers 15 f. deep; estimate, $154,000, **81**, 2437; **86**, 343. Modified in 1889 to provide for the maintenance of existing works and of a channel 200 f. wide and 16 f. deep at extreme low water. Estimate for completion, including appropriation of 1890, $31,400, **90**, 2852.

By Capt. Kingman, 1891, to secure and maintain, by pier extension and dredging, a channel of navigable width and 15 f. depth at extreme low water; estimate for completion, $109,650, **92**, 2556.

By the Chief of Engineers, 1896, for modification of the project to obtain and preserve a depth of 16 f. at low water by dredging without further extension of the piers at this time, **97**, 3270; **98**, 2799.

By Capt. Fitch, 1899, for applying appropriation of 1899 to redredging channel between piers to a provisional width of 150 f., and to repairs of piers, **99**, 3131.

**Surveys.**

By Capt. T. W. Maurice, 1828, **74**, 247.

Under direction of Maj. J. M. Wilson, **73**, 359; **74**, 248.

Minor surveys, **94**, 2459; **97**, 3270; **98**, 2800; **99**, 3131; **1900**, 4163.

MAPS.

Of Genesee River Harbor, **76**, ii, 582.

Harbor, June 30, 1879, **79**, 1728.

**81**, 2436; **94**, 2458.

## CHATHAM HARBOR (STAGE HARBOR), MASS.

**Appropriations.**

| | | |
|---|---|---|
| 1890 | $5,000.00, | **91**, 667. |
| 1896 | 5,000.00, | **96**, 615. |
| 1899 | 3,732.79, | **99**, 1093. |

Total, 13,732.79

**Contracts.**

**1891.** C. W. Anthony, dredging, 41 cents per c. y., **92**, 596.

**1899.** A. E. Smith, dredging 25,312 c. y., 32 cents per c. y; bowlder removal over 3 tons, $10, **99**, 1094; annulled, **1900**, 1217.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 46; **92**, 51; **93**, 52; **94**, 49; **95**, 53; **96**, 53; **97**, 62; **98**, 69; **99**, 80; **1900**, 92.

ENGINEERS IN CHARGE:

Lt. Col. S. M. Mansfield, 1890–98. Reports, **91**, 667; **92**, 595; **93**, 786; **94**, 566; **95**, 641; **96**, 615; **97**, 858; **98**, 882.

Col. C. R. Suter, 1899–. Reports, **99**, 1093; **1900**, 1217.

**Operations.**

**1891–92.** 8,794 c. y. dredged, **92**, 595.

**1899–1900.** 1,447 c. y. dredged (contract annulled), **1900**, 1217.

**Projects.**

By Lt. Col. Mansfield, 1890, inner harbor excavation, channel 6 f. deep at mean low water, through the three obstructing bars, 100 f. wide at the inner and 200 f. wide at the outer end; estimate, $10,000, **91**, 667; estimate increased by $3,732.79, 1896, **97**, 859.

By Col. Suter, 1899, for expenditure of available funds, **99**, 1093.

## CHATHAM NEW HARBOR, MASS.

**Commerce.**
Sixty to 100 catboats make the harbor in the summer season, **95**, 648.

**Engineers.**
Chief of Engineers. Report, **95**, 54.
Engineer in Charge. Lt. Col. S. M. Mansfield, 1894–95. Report, **95**, 647.

**Physical characteristics.**
Description of; a pool or inlet formed, 1851, in the drifting sands, **95**, 647.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made by Lt. Col. Mansfield, 1894 (report unfavorable), **95**, 647.

## CHATTAHOOCHE AND FLINT RIVERS, ALA., FLA., AND GA.[a]

(See *Surveys.*)

| Part. | Appropriations. |
|---|---|
| A.—Chattahooche and Flint rivers, Ala., Fla., and Ga | $122,000 |
| B.—Chattahooche River, Ala. and Ga | 290,000 |
| C.—Flint River, Ga | 176,000 |
| Total | 588,000 |

### Part A.—Chattahoochee and Flint Rivers, Ala., Fla., and Ga.

**Appropriations.**
1835,[b] $2,000, act Feb. 24.
1874, 25,000, **74**, 76,876; **75**, 81.
1875, 25,000, **75**, 82.
1876, 20,000, **76**, 73,495.
1878, [b]18,000, **78**, 170; **79**, 819.
1878, [b]10,000, **78**, 170; **79**, 819.
1879, [b]15,000, **79**, 102, 816, 818.
1879, [c]7,000, **79**, 818.

Total, 122,000

**Commerce.**
Statistics, Chattahooche and Flint, **77**, 416; **78**, 592; **79**, 816. Chattahooche, **72**, 625; **73**, 702. Flint, **73**, 709; **79**, 821.

**Engineers.**
Chief of Engineers. Reports, **71**, 69; **72**, 63, 64; **73**, 67, 68; **74**, 76; **75**, 81; **76**, 73; **77**, 71; **78**, 80, 81, 105; **79**, 101, 102, 142.

Engineers in Charge:
Col. J. H. Simpson, 1871. Report, **72**, 584.
Capt. A. N. Damrell, 1873–. Reports, **73**, 699, 707; **74**, 896; **75**, ii, 10; **76**, 494; **77**, 415; **78**, 591, 592; **79**, 814, 817, 818.

Assistants:
C. F. Trill. Report, **72**, 623.
M. J. Mack. Report, **73**, 698.
W. Griswold. Report, **73**, 700.
H. A. Pattison, **73**, 707.
H. K. Hodges. Report, **73**, 708.
H. Oladowski, **75**, ii, 10.
P. Robinson. Report, **79**, 818.

**Estimates.** (For Chattahooche, unless otherwise stated.)
By C. F. Trill, 1872, improvement of the river from Columbus to its mouth, at Apalachicola: 1st, $464,000; 2d, $327,000; 3d, $85,185, **72**, 63, 585, 629–635.
By Capt. Damrell, W. Griswold, and M. J. Mack, 1873, Columbus, Ga., to Chattahoochee: 1st, $63,333; 2d, $81,914; 3d, $982,945, **73**, 700, 704–707.
By Capt. Damrell, 1873, removal of snags, rock, gravel, etc., and construction of dams, $145,247.66, **74**, 897. In 1879, to complete existing project, $105,000, and $5,000 annually for maintenance, **79**, 816.
By Capt. Damrell and H. K. Hodges, 1873, 3-f. channel in Flint River, Chattahoochee to Albany, $184,862, **73**, 707, 721; **74**, 897. Completion of existing project, $105,000, and $2,000 annually for maintenance, **79**, 818.
By Capt. Damrell and P. Robinson, 1879, Flint River, Albany to Montezuma, $15,000 to $15,100, **79**, 819, 820.
By Capt. Damrell, 1873, Chattahoochee and Flint rivers, $330,109.66, **74**, 897.

**Operations.**[d]
Chattahoochee River.
**1874–75.** Confined chiefly to Wolfax Bar. A wreck, 500 c. y. sand, gravel, and rock, a large number of snags, sunken logs, and overhanging trees removed from above and below the bar; 275 f. of jetty built, **75**, 81, ii, 10.
**1875–76.** Jetty extended 235 f.; construction of 200 f. of new jetty below the bar and 380 f. of breakwater; obstructions removed, **76**, 73, 495.
**1876–77.** Snags, etc., removed, jetties repaired, extension of breakwater 560 f., and several shoals improved by blasting, **77**, 71, 415.

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[a] Survey.—Report, July 4, 1853; estimate, $30,000. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] Chattahoochee.
[c] Flint.
[d] History of operations to 1870, **79**, 814, 817.

## CHATTAHOOCHEE AND FLINT RIVERS, ALA., FLA., AND GA.—Continued.

### Part A.—Chattahoochee and Flint Rivers, Ala., Fla., and Ga.—Continued.

**1877–78.** Completion of 4-f. channel over Wolfax Bar by construction of shore-protection jetties and wing-dams; snags and logs removed; channel 60 f. by 4 f. obtained by blasting rock on shoals, **78**, 80, 591.

**1878–79.** Snags and trees removed, jetties repaired, and 640 f. of brush wing-dams built at Upatoir Bar, **79**, 101, 591.

FLINT RIVER.

**1875–76.** Obstructions removed, **76**, 495.

**1877–78.** 60-f. by 4-f. channel obtained between Bainbridge and Lamberts Island by blasting rock and the removal of sunken logs, etc., **78**, 80, 592.

**1878–79.** Completion of improvements at Lamberts Island, Broad Axe, Bryants Rocks, Cross Chute, and Red Bluff, **79**, 102, 817.

**Physical characteristics.**

Of Chattahoochee, **72**, 627; **73**, 702.

Of Flint, **73**, 707, 713; **79**, 820.

**Plans.** (See *Estimates*.)

By Capt. Damrell, W. Griswold, and M. J. Mack, 1873, between Chattahoochee, Fla., and Columbus, Ga., removal of obstructions, and deepening and widening the channel, **73**, 700, 704–707.

**Private (State) work.**

Indifferent results obtained from appropriations from the State prior to the war, **72**, 627.

**Projects.** (See *Estimates* and *Plans*.)

By Capt. Damrell, 1873, 4-f. channel in Chattahoochee, by removing obstructions and straightening and widening channel, **73**, 700; **74**, 897.

By Capt. Damrell, 1873, 3-f. channel in the Flint River, below Albany, by blasting, dredging, wing-dams, etc., **73**, 707; **74**, 897. In 1879, removal of obstructions from Albany to Montezuma, **79**, 819.

**Surveys.**

CHATTAHOOCHEE RIVER.

Early attempts at, **72**, 627.

By C. F. Trill, under direction of Col. Simpson, 1871–72, from Columbus to Eufaula. Reports, **72**, 584, 623.

By W. Griswold and M. J. Mack, 1872, under direction of Col. Simpson and Capt. Damrell, Eufaula to mouth at the junction with the Flint, **73**, 699, 700.

Under direction of Capt. Wm. R. King, above Columbus, **78**, 105; **79**, 142.

FLINT RIVER.

By H. K. Hodges and H. A. Pattison, 1872–73, under direction of Col. Simpson and Capt. Damrell, from Chattahoochee, Fla., to Albany, Ga. Reports, **73**, 707, 708.

By P. Robinson, 1878–79, under direction of Capt. Damrell, Albany to Montezuma. Reports, **79**, 818, 820.

### Part B.—Chattahoochee River, Ala. and Ga.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $20,000, | **80**, | 1073. |
| 1881, | 20,000, | **81**, | 1186. |
| 1882, | 25,000, | **82**, | 1261. |
| 1884, | 35,000, | **84**, | 1167. |
| 1886, | 20,000, | **86**, | 1169. |
| 1888, | 20,000, | **88**, | 1183. |
| 1890, | 20,000, | **90**, | 1648. |
| 1892, | [a]25,000, | **92**, | 1406. |
| 1894, | [a]30,000, | **95**, | 1620. |
| 1896, | [a]25,000, | **96**, | 1357. |
| 1899, | [a]50,000, | **99**, | 1662. |

Total, 290,000

**Commerce.**

Navigation benefited by improvement, **90**, 1646.

Description of, **93**, 1700; **96**, 1363; **97**, 1619.

The maintenance of a good navigable channel of great importance to a large section of country extending from Columbus, Ga., to Apalachicola, Fla., **93**, 1700.

In 1897–98 apparently no commerce, West Point to Franklin, **98**, 1393.

**Contracts.**

**1888.** M. A. Sweeney & Bro., drilling barge, $3,400; dumping flat, $600, **89**, 1395.

**1900.** M. A. Sweeney Shipyard & Foundry Co., dipper dredge, $13,749, **1900**, 2109.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 134, 190; **81**, 182, 189; **82**, 177, 252; **83**, 188; **84**, 196; **85**, 202; **86**, 200; **87**, 169; **88**, 156; **89**, 181; **90**, 164; **91**, 199, 211; **92**, 195; **93**, 215; **94**, 200, 201; **95**, 227; **96**, 201; **97**, 256, 257; **98**, 252, 253; **99**, 293, 294; **1900**, 333, 334, 344.

ENGINEERS IN CHARGE:

Maj. W. R. King, 1878–80. Reports, **80**, 1705; **82**, 1875.

Maj. A. N. Damrell, 1880–85. Reports, **80**, 1070; **81**, 1182; **82**, 1259; **83**, 973; **84**, 1167.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1303; **86**, 1168; **87**, 1283; **88**, 1181.

Capt. P. M. Price, 1889–93. Reports, **89**, 1393; **90**, 1645; **91**, 1702; **92**, 1405; **93**, 1698.

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[a] See Projects.

## CHATTAHOOCHEE AND FLINT RIVERS, ALA., FLA., AND GA.—Continued.

### Part B.—Chattahoochee River, Ala. and Ga.—Continued.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1258, 1261; **95**, 1619, 1623; **96**, 1356, 1364; **97**, 1616, 1620; **98**, 1387, 1393.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1660, 1663; **1900**, 2106, 2110.

ASSISTANTS:

B. W. Frobel. Report, **80**, 1708.

D. L. Sublett. Report, **80**, 1719.

T. Robinson. Reports, **89**, 1395; **90**, 1646; **91**, 1758.

**Operations.**

**1879–80.** Barge, magazine boat, and scow built; 2,693 l. f. jetty built; 51 snags and 585 c. y. rock removed, **80**, 1071.

**1880–81.** 2 barges built, 1 steamer repaired, 176 c. y. rock removed, **81**, 1183.

**1881–82.** 640 snags and trees removed, 1,682 l. f. jetty built, and 77 l. f. repaired; 2,614 c. y. rock removed, 960 cords brush fascines constructed, **82**, 1259.

**1882–83.** 292 snags and trees and 1,968 c. y. rock removed; 2,060 l. f. jetty built, **83**, 973.

**1883–84.** 634 snags and trees and 2,531 c. y. rock removed; 2,377 l. f. of brush jetties built; 2 barges, 2 skiffs, and 3 bateaux built, **84**, 1168.

**1884–85.** 1,100 snags, logs, and trees, 3 wrecks from channel, and 3,764 c. y. rock removed, **85**, 1304.

**1885–86.** 4,473 c. y. rock removed; steam snag boat completed and equipped, **86**, 1168.

**1886–87.** 1,733 logs and trees removed by United States snag boat; 3,007 c. y. marl excavated at Uchee Shoals, **87**, 1284.

**1887–88.** 3,818 c. y. marl and 1,354 snags, logs, and trees removed from the river; repairs made to jetties at Mound Bar, **88**, 1182.

**1888–89.** 753 c. y. rock and 2,225 logs, snags, and overhanging trees removed from the channel, **89**, 1395.

**1889–90.** 576 c. y. rock and 904 snags and logs removed from the channel, **90**, 1647.

**1890–91.** 25 trees cleared from the banks, 10 snags and 166 c. y. marl removed from the channel, and extensive repairs made to snag boat *Chattahoochee*, **91**, 1702.

**1891–92.** 366 snags and 1,500 c. y. gravel removed from channel; 1,100 l. f. pile-and-brush bank protection and jetty work built, **92**, 1406.

**1892–93.** 1,500 obstructions removed, 805 c. y. gravel and 567 c. y. rock removed, 1,700 l. f. dams and 400 s. y. protection mats constructed, and the hull of an old boat sunk to form a jetty 135 l. f. long, **93**, 1699, 1702.

**1893–94.** 66 obstructions removed from the banks and stream, and 270 c. y. rock excavated and removed, 2 spur dams were built and repairs made to snag boat, and 178 l. f. training dams were built, **93**, 1259, 1263.

**1894–95.** 450 obstructions were removed, 257 c. y. rock removed, 11,282 c. y. gravel and sand removed, 600 s. y. bank protection built, and 1,953 l. f. dams repaired, **95**, 1621, 1625.

**1895–96.** 29 obstructions removed, 4,165 s. y. plowed, 695 c. y. gravel removed by scrapers, 230 l. f. longitudinal dikes and 30 l. f. shore protection built; repairs were made to dikes, rebuilding of snag boat was in progress, and 395 c. y. rock were excavated and removed, **96**, 1361, 1362, 1364.

**1896–97.** About 1,600 obstructions and 102 c. y. rock removed, and rebuilding of snag boat in progress, **97**, 1617.

**1897–98.** About 2,000 obstructions removed, 25 c. y. rock and about 3,000 c. y. gravel were also removed; 43 c. y. rock were placed as ballast in an old hull, 297 s. y. landslides were plowed, 10 cords of brush were used in making bank protection, 1,950 l. f. bank protection, 1,430 l. f. dams and jetties, and 230 l. f. old dams were repaired, **98**, 1390.

**1898–99.** Snag boat *Chattahoochee* repaired, and some obstructions in channel between Columbus and Burdocks Landing removed, **99**, 1661.

**1899–1900.** 4,574 snags and overhanging trees, 2,942 c. y. rock and clay, and a wreck removed from banks and channel; jetties repaired and willows planted for shore protection, **1900**, 2107, 2108.

**Physical characteristics.**

Description of, **97**, 1618; **98**, 1387, 1390.

Description of, West Point to Franklin, **93**, 1701; **94**, 1261.

**Plans.** (See *Projects.*)

By Maj. King, 1880, Chattahoochee River, excavation of channel through ledges and bars, removal of isolated and projecting rocks, and the building of jetty dams to contract the channel to its normal width. Also by the construction of locks and dams where the fall is too great to be overcome by open-channel navigation. Estimate, $6,403,811, **80**, 1708, 1721.

By Maj. King, 1882, West Point to Bolton, 108 miles, slackwater navigation by dredging, wing and riprap dam construction, and the construction of 8 locks. Estimate, $486,474. **82**, 1876.

**Private (corporate) work.**

The Chattahoochee Navigation Co. caused a survey to be made of the river, West Point to Franklin, 1890, **93**, 1702.

**Projects.** (See *Plans.*)

By Capt. Damrell, 1873, Chattahoochee River, mouth to Columbus, 224 miles, formation of channel 100 f. wide and 4 f.

## CHATTAHOOCHEE AND FLINT RIVERS, ALA., FLA., AND GA.—Continued.

### Part B.—Chattahoochee River, Ala. and Ga.—Continued.

deep at low water, by blasting, dredging, removal of snags and logs, and the construction of wing dams, **73**, 700; **80**, 1070; **86**, 200. Original estimate, $385,274, **86**, 1169; **87**, 1283.

Acts of 1892, 1894, 1896, 1899 each appropriated $5,000 for between West Point and Franklin.

By Capt. Price, 1892, for the removal from the river between West Point and Franklin of the lesser rock shoals, sand, and gravel bars by excavation and by works of contraction; removal of overhanging trees from the banks, and snags, logs, and other obstructions from the channel, and the construction of locks and dams to overcome the more serious obstructions to give a minimum depth of 3 f. at low water; estimate, $364,340.43, **93**, 1702, 1703. This project was abandoned with the exception of clearing obstructions, and in 1895 Maj. Mahan recommended that the whole work be abandoned on account of the poor results, **95**, 1625.

**Surveys.**

Survey above Columbus ordered by act of June 18, 1878, made under direction of Maj. King in 1880, **80**, 1705.

Survey between West Point and Bolton ordered by act of March 3, 1879, made in 1881 under direction of Capt. Damrell, **81**, 189.

Examination of river between West Point and Bolton ordered by act of March 3, 1881, made, 1882, under direction of Maj. King, **82**, 1875.

Examination between West Point and Franklin ordered by act of September 19, 1890, made, 1890, under direction of Capt. Price (Col. Comstock's report unfavorable), **91**, 1757.

Survey of Chattahoochee River, Ga., West Point to Franklin, ordered by act of March 3, 1899, in progress, **1900**, 344.

MAPS. **80**, 1708; **93**, 1700; **98**, 1392.

### Part C.—Flint River, Ga.

**Appropriations.**

1880, $20,000, **80**, 1075.
1881, 15,000, **81**, 1188.
1882, 25,000, **82**, 1263.
1884, 20,000, **84**, 1173.
1886, 20,000, **86**, 1164.
1888, 20,000, **88**, 1177.
1890, 20,000, **90**, 1639.
1892, 15,000, **92**, 1404.
1894, 8,000, **95**, 1619.
1896, 8,000, **96**, 1355.
1899, 5,000, **99**, 1658.

Total, 176,000

**Commerce.**

Important, **83**, 977.

Increase in river business due to improvement, **88**, 1178.

Comparatively unimportant, **93**, 1697.

**Contracts.**

**1888.** M. A. Sweeney & Bro., snag boat, dumping flat, and drilling barge, $4,800, $600, and $3,400, respectively, **89**, 1389.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 134; **81**, 182; **82**, 178; **83**, 188; **84**, 196; **85**, 201; **86**, 199; **87**, 167, 171; **88**, 155; **89**, 180, 185; **90**, 161; **91**, 198; **92**, 194; **93**, 213; **94**, 198; **95**, 225; **96**, 200; **97**, 255; **98**, 251; **99**, 292; **1900**, 332.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1873–85. Reports, **80**, 1073; **81**, 1186; **82**, 1261; **83**, 975; **84**, 1170.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1298; **86**, 1162; **87**, 1278, 1290; **88**, 1175.

Capt. P. M. Price, 1889–93. Reports, **89**, 1385, 1420; **90**, 1637; **91**, 1698; **92**, 1402; **93**, 1695.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1255; **95**, 1617; **96**, 1351; **97**, 1612; **98**, 1383.

Capt. C. A. F. Flagler, 1899—. Reports, **99**, 1657, **1900**, 2101.

ASSISTANTS:

P. M. Slaughter. Report, **87**, 1290.

T. Robinson. Reports, **89**, 1387, 1422; **90**, 1638; **91**, 1699; **92**, 1403.

**Obstructions.**

Two bridges without draw openings above Albany in 1895 prohibited steamboat navigation at the higher stages of the water, **95**, 1617.

**Operations.**

**1879–80.** 1,280 c. y. rock and 103 snags removed; 2 barges built and 1 repaired, **80**, 1074.

**1880–81.** 390 l. f. of dam built; 2,393 c. y. rock removed, **81**, 1187.

**1881–82.** 2,627 c. y. rock removed; 350 l. f. stone dam built; 3,460 snags and trees cut and removed, **82**, 1262.

**1882–83.** 4,821 trees and snags removed; 2,439 c. y. rock removed, **83**, 976.

**1883–84.** 2,392 snags removed; 2,954 c. y. rock removed, **84**, 1171.

**1884–85.** 12,961 snags and 2,202 c. y. rock removed, **85**, 1299.

**1885–86.** 1,254 snags and 5,477 c. y. rock removed, **86**, 1163.

**1886–87.** 3,232 trees, logs, and snags and 4,261 c. y. rock removed, **87**, 1280.

**CHATTAHOOCHEE AND FLINT RIVERS, ALA., FLA., AND GA.**—Continued.

**Part C.—Flint River, Ga.**—Continued.

**1887–88.** 585 snags and trees and 5,325 c. y. rock removed from the river, **88**, 1177.

**1888–89.** 450 snags, 1,815 c. y. solid rock, and 817 c. y. bowlders and loose rock removed from the channel, and 1,461 trees cut from the banks, **89**, 1388.

**1889–90.** 980 snags, 1,412 c. y. rock, ferryboat wreck, and steamer's boiler removed from the channel, **90**, 1638, 1639.

**1890–91.** 320 snags and 15 c. y. rock removed from the channel, and 1,723 trees cleared from the banks, **91**, 1699.

**1891–92.** 2,229 snags and 3,203 c. y. rock removed from the channel; 2,160 trees cleared from the banks, **92**, 1403.

**1892–93.** About 2,800 obstructions removed from banks and channel, and 177 l. f. training dams constructed, **93**, 1697.

**1893–94.** About 1,300 obstructions removed, **94**, 1256.

**1894–95.** 74 obstructions and 413 c. y. rock removed, and 247 c. y. rock deposited in dams, **95**, 1618.

**1895–96.** About 130 obstructions and 1,667 c. y. rock removed, and 1,033 c. y. rock deposited in spur dams, **96**, 1354.

**1896–97.** About 80 obstructions and 1,510 c. y. rock removed, and 842 c. y. deposited in spur dams, **97**, 1613.

**1898–99.** Drilling barge repaired and a few isolated bowlders removed, **99**, 1658.

**1899–1900.** 901 snags and other obstructions removed from banks and channel. and 1,835 c. y. rock dredged, **1900**, 2103.

**Physical characteristics.**
Description of, **97**, 1612; **98**, 1383.

**Plans.** (See *Projects.*)
By Capt. Hoxie, 1887, extension of the improvement from Montezuma to Old Agency by the removal of obstructions. Estimate, $25,000. **87**, 1290, 1291.
In 1889 Capt. Price reported it advisable to postpone removal of the rock reefs at Albany until the completion of the improvement above, **89**, 1421.

**Projects.** (See *Plans.*)
By Capt. Damrell, 1873, modified in 1880 after more detailed surveys, low-water navigable channel 3 feet deep and 100 feet wide, mouth to Albany, Ga., 105 miles, and a navigable channel for light-draft steamers, at moderate stages of water, Albany to Montezuma, 100 miles, by removal of snags, scouring bars, by works of contraction, and cutting through rock reefs; estimate, $199,962, **73**, 707, 721; **80**, 1073; **86**, 1162; **87**, 1278; **91**, 1700.

**Surveys.**
Examination from Montezuma to Old Agency ordered by act of Aug. 6, 1886, made under direction of Capt. Hoxie, **87**, 1290.
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Price, **89**, 1420.
Maps. **93**, 1696.

**CHATTAHOOCHIE BAY AND RIVER.** (See *Gulf of Mexico.*)

**CHATTANOOGA.** (See *Tennessee River.*)

**CHAZY RIVER.** (See *Great Chazy, N. Y.*)

**CHEAT RIVER, W. VA.**

**Appropriation.**
1890, $13,000, **91**, 2361.

**Engineers.**
Chief of Engineers. Reports, **89**, 254; **91**, 291; **92**, 279; **93**, 315; **94**, 291; **95**, 326.

Engineers in Charge.
Lt. Col. W. E. Merrill, 1888–92. Reports, **89**, 1905; **91**, 2361.
Maj. A. Stickney, 1892–93. Reports, **92**, 1991; (Lt. Col.) **93**, 2496.
Capt. R. L. Hoxie, 1894–95. Reports, **94**, 1911; (Maj.) **95**, 2404.

Assistants.
C. E. Rees. Report, **89**, 1906.
P. Golay. Reports, **91**, 2361; **92**, 1991; **93**, 2497; **95**, 2405.

**Operations.**
**1890–91.** 5,626 c. y. rock cleared from the channel, **91**, 2361.
**1891–92.** 8,221 c. y. rock blasted and removed from the channel, **92**, 1991.

**Physical characteristics.**
Description of, **89**, 1905.

**Projects.**
By Lt. Col. Merrill, 1889, mouth at Point Marion to Rowlesburg, W. Va., 49 miles, blasting and removing rock obstructions to give a raft navigation; estimate, $13,000, **89**, 1906; **91**, 2361.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Merrill, **89**, 1905.

## CHEBOYGAN HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1871, | $10,000, | **71**, 43. |
| 1872, | 15,000, | **72**, 40. |
| 1873, | 15,000, | **73**, 40. |
| 1874, | 15,000, | **74**, 46. |
| 1875, | 15,000, | **75**, 51. |
| 1876, | 10,000, | **76**, 104. |
| 1878, | 8,000, | **78**, 127, 1238. |
| 1879, | 3,000, | **79**, 169, 1667. |
| 1880, | 6,000, | **80**, 2035. |
| 1881, | 6,000, | **81**, 2242. |
| 1882, | 10,000, | **82**, 2328. |
| 1884, | 5,000, | **84**, 2036. |
| 1886, | 15,000, | **86**, 1824. |
| 1888, | 15,000, | **88**, 1960. |
| 1896, | 12,000, | **96**, 2724. |
| 1899, | 8,000, | **99**, 2982. |
| Total, | 168,000 | |

**Commerce.**

Important, **73**, 290; **74**, 200; **76**, ii, 529, 531.

Description of, **1900**, 4014.

**Contracts.**

**1871.** Caskin & Stickney, dredging, 28 cents per c. y., **71**, 173, 174.

**1872.** Caskin & Stickney, dredging, 22½ cents per c. y., **72**, 203.

**1873.** Caskin & Stickney, dredging, 22 cents per c. y., **73**, 290.

**1874.** Caskin & Stickney, dredging, 19 cents per c. y., **75**, 271.

**1875.** E. T. Williams & Co., dredging, 17 cents per c. y., **75**, 271, 272.

**1878.** Caskin, Stickney & Cram, dredging, 11½ cents per c. y., **79**, 1667.

**1880.** Caskin, Stickney & Cram, dredging, 17 cents per c. y., **81**, 2242.

**1881.** J. W. McGinn, pier construction, **81**, 2243.

**1883.** Caskin, Stickney & Cram, dredging, **83**, 1851.

**1887.** Green Bay Dredging Co., dredging, 11½ cents per c. y., **87**, 2249. C. F. Mitchell, dredging, 14.4 cents per c. y., **88**, 1960.

**1895.** C. E. Mitchell, dredging, 12.9 cents per c. y., **95**, 2824.

**1899.** C. E. Mitchell, dredging, 14.7 cents per c. y., **1900**, 3974.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 31; 44; **71**, 43; **72**, 40; **73**, 40; **74**, 46; **75**, 51; **76**, 104; **77**, 112; **78**, 127; **79**, 169; **80**, 219; **81**, 297; **82**, 292; **83**, 301; **84**, 303; **85**, 326; **86**, 320; **87**, 288; **88**, 261, **89**, 309; **90**, 278; **91**, 348; **92**, 334; **93**, 380; **94**, 353; **95**, 389; **96**, 344; **97**, 440; **98**, 429; **99**, 510, 522; **1900**, 574, 587.

ENGINEERS IN CHARGE:

Capt. F. U. Farquhar, survey in 1870. Report, **71**, 183.

Maj. O. M. Poe, 1871–73. Reports, **71**, 172; **72**, 203.

Maj. G. Weitzel, 1873–77. Reports, **73**, 290; **74**, 200; **75**, 271; **76**, ii, 529.

Maj. F. Harwood, 1877–83. Reports, **77**, 944; **78**, 1236; **79**, 1666; **80**, 2034; **81**, 2241; **82**, 2327.

Lt. Col. O. M. Poe, 1883–92. Reports, **83**, 1850; **84**, 2035; **85**, 2128; **86**, 1824; **87**, 2247; (Col.), **88**, 1958; **89**, 2243; **90**, 2719; **91**, 2764; **92**, 2448.

Maj. W. Ludlow, 1893. Report, **93**, 2917.

Lt. Col. G. J. Lydecker, 1894–. Reports, **94**, 2239; **95**, 2823; **96**, 2723; **97**, 3009; **98**, 2576; **99**, 2982; **1900**, 3973, 4012.

ASSISTANTS:

R. J. Cram, **71**, 183.

Capt. A. N. Lee. Reports, **75**, 271; **76**, ii, 529.

B. H. Muehle. Report, **1900**, 4014.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Poe, 1871, to complete a straight channel 120 f. wide by 12 f. deep across the bar, without protection of its banks, $50,000, **72**, 203.

By Maj. Weitzel, 1873, to complete the channel and revet about 2,500 f. of its banks, $75,000, **73**, 290; **74**, 200.

By Maj. Harwood, 1879, to complete the improvement, $25,000, **79**, 1666.

**Operations.**

**1870–71.** Dredging a channel 9 f. in depth in progress, **71**, 43.

**1871–72.** 32 c. y. removed; channel 50 f. wide by 9 f. deep, **72**, 40, 203.

**1872–73.** Dredging continued; a channel 12 f. in depth obtained, **73**, 40.

**1873–74.** Dredging continued, making channel 13 f. in depth; 76,955 c. y. removed, **74**, 46.

**1874–75.** 30,156 c. y. removed, **75**, 51.

**1875–76.** 114,368 c. y. removed, **76**, 104; ii, 529.

**1877–78.** 58,510 c. y. removed; entrance channel 150 to 175 f. wide, 200 f. wide abreast of steamboat docks; clear depth of 13 f. obtained, **78**, 127, 1236.

**1878–79.** Dredging continued; channel 200 f. by 13 f., **79**, 169.

**1879–80.** 9,843 c. y. dredged from channels, **80**, 2035.

**1880–81.** 12,369 c. y. dredged, **81**, 2241.

**1881–82.** 12,000 c. y. dredged from channel, **82**, 2327; construction of pier-head crib, **82**, 2328.

**1882–83.** 28,000 c. y. removed, **83**, 1850.

**1887–88.** 29,979 c. y. dredged, **88**, 1959.

## CHEBOYGAN HARBOR, MICH.—Continued.

**1888–89.** 28,472 c. y. dredged, **89**, 2244.

**1889–90.** 31,204 c. y. dredged, project completed, **90**, 2720.

**1894–95.** 36,086 c. y. dredged, **95**, 2824.

**1895–96.** 74,515 c. y. dredged, **96**, 2724.

**1898–99.** 106,115 c. y. dredged, **1900**, 3974.

**Physical characteristics.**

Description of, **71**, 183, 184; **76**, ii, 530; **1900**, 4013.

Most unusual scour, 1898–99, increasing depth by 3 f., **99**, 2982.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Farquhar, 1870, reducing width of channel to 100 f., $334,157.43, **71**, 183–186.

**Private work.**

$2,000 was contributed by the citizens to improve the river by dredging inside of the inner end of the improvement by the United States, **72**, 204; **76**, ii, 531.

**Projects.** (See *Estimates* and *Plans.*)

By Capt. Farquhar, 1870, dredging channel 200 f. wide by 14 f. deep, mouth of river to Cheboygan village, and the protection of the channel by pile piers with crib pier heads. Estimate, $395,000. **71**, 185, 186; **80**, 219; **87**, 2247.

By Maj. Poe, modification of Capt. Farquhar's plan for making channel 50 f. wide at bottom and 9 f. deep; to increase the channel to 100 f. in width by 12 f. in depth, **71**, 172; **72**, 203.

By Maj. Weitzel, revetting part of the cut to protect the banks, dredging 13 f. deep, and to increase the width to 180 f., **73**, 290; **75**, 271; **76**, ii, 529.

History of projects, **76**, ii, 530, 531.

By Maj. Harwood, to dispense with the revetment (as unnecessary) and to increase channel to 200 f. in width, **77**, 945. For additional dredging about the axis of the channel and a protecting pier on the west border, **79**, 169, 1666.

Revised project by Maj. Harwood, 1882, providing a uniform depth of 15 f. throughout channel and of basin opposite steamboat landing, **82**, 2328; **87**, 2247.

In 1885 Col. Poe reduced the estimate to $218,000, **85**, 2128; **87**, 2248. In 1888 Col. Poe proposed the continuation of the 15-f. channel upstream to the State Road Bridge. The project, therefore, is for a channel 15 f. deep and 200 f. wide, 15-f. curve in the Straits of Mackinaw to the first bridge, and the revetting of both sides of the channel outside the shore line; estimate, $218,000, **88**, 1959.

Project completed in 1890; cost, $129,648, **91**, 2720; **92**, 2448.

In 1895 Lt. Col. Lydecker estimated it would cost $33,000 to improve the harbor by dredging to a depth of 18 f. and a full width of 200 f. from the 18-f. curve in the Straits to the outer end of the west pier, and inside of that point between lines parallel to and 25 f. from the piers, the plan of improvement adopted, **95**, 2823.

Lt. Col. Lydecker estimated, 1900, it would cost $15,500 for an 18-f. channel, **1900**, 4014.

**Surveys.**

Importance urged by Col. Cram, **69**, 113.

Under Capt. F. U. Farquhar, by R. J. Cram. Reports, **70**, 44; **71**, 183–186.

Of channel, 1880, **80**, 2035.

Estimate of amount required to deepen the existing channel, 1895, to 18 f., required by act of Aug. 17, 1894; survey made, 1895, by Lt. Col. Lydecker for that purpose (see *Projects*), **95**, 2825.

Examination of the harbor made, 1897, by Lt. Col. Lydecker, **97**, 2577.

Examination and survey, with a view to establishing an 18-f. channel, entrance to the first bridge, ordered by act of Mar. 3, 1899, made under direction of Lt. Col. Lydecker (report favorable; see *Projects*), **1900**, 4012.

Maps, **82**, 2328; **95**, 2824.

## CHEESEQUAKES CREEK, N. J.

**Appropriations.**

1880, $20,000, **80**, 524.
1881, 5,000, **81**, 664.
1882, 15,000, **82**, 681.

Total, 40,000

**Contracts.**

**1882.** S. R. Cumming, revetment, **83**, 570.

**Engineers.**

Chief of Engineers. Reports, **80**, 85; **81**, 107; **82**, 108; **83**, 104; **84**, 110; **85**, 101; **86**, 106; **87**, 73; **88**, 73.

Engineers in Charge:

Col. J. Newton, 1879–82. Reports, **80**, 524; **81**, 663; **82**, 679.

Lt. Col. G. L. Gillespie, 1882–86. Reports, **83**, 569; **84**, 735; **85**, 743.

Lt. Col. W. McFarland, 1886. Report, **86**, 763.

Lt. G. McC. Derby, 1886–88. Report, **87**, 775; (Capt.), **88**, 661.

Assistant. R. H. Talcott. Report, **80**, 525.

**Operations.**

**1882–83.** 2,000 l. f. of stone jetty constructed; channel dredged, **83**, 569.

## CHEESEQUAKES CREEK, N. J.—Continued.

**1883–84.** Rubble jetties raised by adding 750 c. y. stone, channel widened to 100 f.; 532 f. of sheet pile revetment built, **84**, 736.

**Physical characteristics.**
Described, **80**, 526.

**Projects.**
By Col. Newton, 1879, to change the outlet into a direction at a right angle to the beach and to sustain this direction by parallel jetties to strengthen the course of the stream and increase the depth to 4 f. at m. l. w.; estimate, $75,279, **80**, 525, 527; **82**, 680. Estimate revised in 1885 to $90,000, **85**, 743; **87**, 743.

**Survey.**
Ordered by act of Mar. 3, 1879; made in 1880, under direction of Col. Newton, **79**, 66; **80**, 525.

Maps. **82**, 680.

## CHEFUNCTE (TCHEFUNCTE) RIVER AND BOGUE FALIA (FALAYA), LA. (See *Tchefuncte River.*)

**Appropriation.**

| | | | |
|---|---|---|---|
| 1872, | $6,000, | **73**, | 65, 632. |
| 1881, | [a]1,500, | **81**, | 1284. |
| 1882, | 1,500, | **82**, | 1376. |
| 1886, | [b]2,500, | **86**, | 454. |
| 1890, | 1,000, | **90**, | 1738. |
| 1892, | 1,000, | **92**, | 1483. |
| 1894, | 1,000, | **95**, | 1743. |
| 1896, | 1,000, | **96**, | 1487. |
| 1899, | 1,000, | **99**, | 1834. |
| Total, | 16,500 | | |

**Commerce.**
Local, **71**, 553; **88**, 1244; **95**, 1785.
79,300 tons annually, 1899, **1900**, 2242.

**Contract.**
**1872.** G. Andrews, removing wreck, $4,850, **73**, 633.
**1881.** W. Fagan, removing obstructions, $100 per mile, **82**, 1375.
**1894.** De Witt Dilworth, hire of dredging plant, $125 per day, **95**, 1743.

**Engineers.**
Chief of Engineers. Reports, **71**, 67; **72**, 61; **73**, 65, 632; **79**, 112; **80**, 145, 146; **81**, 193, 197; **82**, 189; **83**, 208; **84**, 211, 216; **85**, 216; **86**, 214; **87**, 179, 188; **88**, 167, 217; **89**, 194, 202; **90**, 175; **91**, 222; **92**, 215; **93**, 239; **94**, 220; **95**, 245, 260; **96**, 215; **97**, 278; **98**, 270; **99**, 318; **1900**, 361.

Engineers in Charge:
Capt. C. W. Howell, 1871–82. Reports, **71**, 552; **73**, 632; (Maj.), **80**, 1181; **81**, 1283; **87**, 1358.
Maj. A. Stickney, 1882–85. Reports, **82**, 1375; **83**, 1109; **84**, 1268, 1283.
Maj. W. H. Heuer, 1885–87. Reports, **85**, 1394; **86**, 1242; **87**, 1358.
Capt. W. L. Fisk, 1888–91. Reports, **88**, 1243; **89**, 1482, 1529; **90**, 1737.
Maj. J. B. Quinn, 1891–99. Reports, **91**, 1818; **92**, 1481; **93**, 1808; **94**, 1349; **95**, 1742, 1784; **96**, 1485; **97**, 1751; **98**, 1464; **99**, 1833.
Maj. H. M. Adams, 1900–. Report, **1900**, 2240.

Assistants:
Lt. E. A. Woodruff. Report, **71**, 552.
Mr. Ripley. Report, **73**, 663.
W. H. Hoffman. Report, **80**, 1181.
H. C. Collins. Reports, **84**, 1269, 1284.
Lt. O. T. Crosby. Reports, **85**, 1395; **86**, 1243; **87**, 1359.

**Operations.**
**1872–73.** Wreck of the Oregon removed, **73**, 65, 634.
**1881–82.** Four miles of river cleaned of obstructions, **82**, 1376.
**1886–87.** Channels through Bogue Falia, between Old Landing and Crompton, deepened, **87**, 180.
**1891–92.** 161 snags and 102 logs removed from the channel, and 143 trees cleared from the banks, **92**, 1482.
**1894–95.** About 3,600 c. y. dredged, **95**, 1743.
**1899–1900.** A bar at the mouth of the Chefuncte River, and several shoals, a wreck, and a number of logs and snags from Bogue Falia were removed, **1900**, 2240.

**Physical characteristics.**
The river, of which Bogue Falia is a tributary, flows into Lake Pontchartrain, La., and is navigable up to Covington, about 12 miles, **71**, 552; **73**, 633; **95**, 1785.

**Plans.** (See *Projects.*)
By Lt. Woodruff, 1871, removing wrecks, snags, etc.; estimate, $16,800, **71**, 552.
By Capt. Howell, 1872, cut-off, Abieta River to Tchefuncte River, $6,574, **73**, 633.
Maj. Stickney, improvement of Bogue Falia River above Covington could not be made at any reasonable cost; below Covington it might be improved by cut-off; estimate reported, $1,856, **84**, 1283.

**Projects.** (See *Plans.*)
The appropriation of $6,000 in 1872 was applied to the removal of the wreck of the gunboat *Oregon*, **73**, 65, 634.

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[a] For Chefuncte River only.

[b] Improving Chefuncte River and Bogue Falia, La.

## CHEFUNCTE (TCHEFUNCTE) RIVER AND BOGUE FALIA (FALAYA), LA.—Continued.

By Maj. Howell, 1880, improving Chefuncte River by removing snags and similar obstructions from the mouth to Covington, and dredging bar at entrance to Lake Pontchartrain; estimate, $5,460, **80**, 1182.

By Maj. Stickney, 1884, for channel across the bar 100 f. wide and 7 f. deep by dredging, and 2,500 l. f. of breakwater; estimate, $20,400, **84**, 1270.

In 1889 Capt. Fisk reported the Chefuncte and Bogue Falia as unworthy of any improvement beyond the annual appropriation of $1,000 for snagging, **89**, 1530.

By Maj. Quinn, 1894, for dredging through the bars below Covington to a depth of 6 f. and width of about 60 f., **95**, 1742.

In 1893 Maj. Quinn estimated it would cost $1,000 annually for maintenance, **93**, 1808.

By Maj. Quinn, 1899, for a 6-f. channel 60 f. wide through the bars at the mouth of the Chefuncte and in the Bogue Falia, **99**, 1834.

**Surveys.**

By Lt. Woodruff, under direction of Capt. Howell. Report, **71**, 551, 552.

By Mr. Ripley, 1872, under direction of Capt. Howell. Report, **73**, 632.

Under direction of Capt. Howell, **79**, 112.

Ordered by act of Mar. 3, 1879; made, 1880, under direction of Maj. Howell, **80**, 1181.

Of Bogue Falia River, ordered by act of June 14, 1880, **80**, 146.

Made under direction of Maj. Stickney, 1884. Report unfavorable in part (see *Plans*). **84**, 1283.

Of Bogue Falia from landings to Covington, La., ordered by act of Aug. 5, 1886, **87**, 188.

Examination ordered by act of Aug. 17, 1894, made in that year by Maj. Quinn, (report favorable), **95**, 1784.

## CHEHALIS RIVER, WASH. (See *Grays Harbor, Wash.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1882, | $3,000, | **82**, | 2686. |
| 1884, | 2,500, | **84**, | 2276. |
| 1886, | 2,500, | **86**, | 2010. |
| 1888, | 2,000, | **88**, | 2175. |
| 1890, | 3,000, | **90**, | 2986. |
| 1896, | 3,000, | **96**, | 3343. |
| 1899, | 3,000, | **99**, | 3266. |
| Total, | 19,000 | | |

**Commerce.**

Important, **75**, ii, 800.

**Contracts.**

**1889.** T. S. Tew, hire of boat and snagging outfit, $31.67 per day, **89**, 2560.

**Engineers.**

CHIEF OF ENGINEERS. Report, **75**, 125; **80**, 332; **81**, 323; **82**, 323; **83**, 337; **84**, 340; **85**, 367; **86**, 364; **87**, 328; **88**, 302; **89**, 360; **90**, 323; **91**, 407; **92**, 382; **93**, 442; **94**, 411; **95**, 452; **96**, 409; **97**, 510; **98**, 514; **99**, 602; **1900**, 680.

ENGINEERS IN CHARGE:

Maj. N. Michler, 1874. Report, **75**, ii, 799.

Capt. C. F. Powell, 1881–88. Reports, **82**, 2686, 2687; **83**, 2075; **84**, 2276; **85**, 2405; **86**, 2009; **87**, 2489.

Maj. T. H. Handbury, 1888–90. Reports, **88**, 2174; **89**, 2559.

Capt. T. W. Symons, 1890–95. Reports, **90**, 2984; **91**, 3236; **92**, 2726; **93**, 3414; **94**, 2604; **95**, 3413.

Capt. H. Taylor, 1896–. **96**, 3343; **97**, 3437; **98**, 3064; **99**, 3266; **1900**, 4476.

ASSISTANTS:

G. W. Cradlebaugh, **75**, ii, 799.

R. A. Habersham. Report, **82**, 2688.

J. M. Clapp. Report, **95**, 3414.

**Operations.**

**1883–84.** 1,611 logs, snags, and pieces of driftwood removed, **84**, 2277.

**1884–85.** 1,711 logs, snags, and pieces of driftwood cut and removed, **85**, 2405.

**1886–87.** 293 logs and snags removed, **87**, 2489.

**1887–88.** 353 snags and 129 overhanging trees removed, **88**, 2175.

**1888–89.** 60 snags and 5 overhanging trees removed, **89**, 2560.

**1889–90.** 56 snags cleared from the channel, **90**, 2985.

**1890–91.** 60 snags and 51 stumps removed from the channel between Montesano and Grays Harbor, **91**, 3237.

**1891–92.** 8 snags cleared from the channel, **92**, 2727.

**1893–98.** Small amount of snagging done, **94**, 2606; **95**, 3414; **97**, 3437; **98**, 3065.

**1899–1900.** Nearly 500 snags removed, **1900**, 4476.

**Physical characteristics.**

General, **75**, ii, 799.

Obstructions, raft at Chehalis Indian Reservation, **75**, ii, 799, 800.

Description of river and its obstructions, **82**, 2687, 2690.

From the nature of the country through which the river runs it is liable to be obstructed by snags after every freshet, **97**, 3437.

## CHEHALIS RIVER, WASH.—Continued.

**Plans.** (See *Projects.*)
By Maj. Michler, removal of rafts near Chehalis Indian Reservation, estimate, $32,500, **75**, ii, 800.

**Projects.**
By Capt. Powell, 1882, removal of snags, logs, drift, and similar obstructions, Claquato to the mouth, 70 miles, giving a navigable channel of 3 f. for two-thirds of the year, estimate annual cost, $8,000, **82**, 2687, 2688.

**Surveys.**
By G. W. Cradlebaugh, 1874–75, **75**, ii, 799.
Ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. Powell, **82**, 2686.
Examination was made in 1893 by Capt. Symons, **93**, 3414.

## CHELSEA RIVER, MASS. (See *Boston Harbor, Mass.*)

**Commerce.**
Description of, **93**, 791.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 52; **95**, 54.
ENGINEER IN CHARGE. Lt. Col. S. M. Mansfield, 1893–95. Reports, **93**, 790; **95**, 648.

**Physical characteristics.**
River empties into Boston Harbor near the mouth of Mystic River. Distance between bridges (see *Surveys*) 7,500 f., its width for about three-quarters of this length 300 f., when it narrows to 100 f., **93**, 791.

**Projects.**
Lt. Col. Mansfield estimated it would cost $65,000 to improve the river, **95**, 649.

**Surveys.**
Examination, Grand Junction R. R. bridge to Boston and Maine R. R. bridge, ordered by act of July 13, 1892, made, 1892, by Lt. Col. Mansfield (report favorable), **93**, 790.
Survey ordered by act of Aug. 17, 1894, made, 1894, by Lt. Col. Mansfield (see *Projects*), **95**, 648.

## CHEQUAMEGON BAY, WIS. (See *Ashland Harbor.*)

## CHERRY ISLAND FLATS. (See *Delaware River.*)

## CHERRYSTONE CREEK, VA.

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 151.
ENGINEER IN CHARGE. Capt. T. Turtle. Reports, **84**, 953, 955.
ASSISTANTS:
W. H. Kimberly. Report, **84**, 955.
I. L. Seager. Report, **84**, 954.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Turtle (report unfavorable), **84**, 953, 955.

## CHESAPEAKE AND DELAWARE CANAL.[a]

**Appropriations.**

| | |
|---|---|
| Mar. 3, 1825, | $300,000 |
| Mar. 2, 1829, | 150,000 |
| Total, | 450,000 |

## CHESAPEAKE AND OHIO CANAL.[b] (See *Transportation routes to the seaboard via Youghiogheny River, to connect with Chesapeake and Ohio Canal.*)

**Appropriation.**[c]
May 24, 1828, $1,000,000.

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[a] First, for 1,500 shares of the canal company, and, again, for 750 shares. (Treasury Doc., 373, 1882.)
[b] Examination—Report (favorable) Feb. 3, 1826; report (indefinite) Dec. 1, 1833. Survey—Report, Oct. 23, 1826; estimate, $22,375,427.69. (H. Doc. No. 482, 55th Cong., 2d sess.)
[c] For 10,000 shares of the capital stock of the canal company. (Treasury Doc. 373, 1882.)

## CHESAPEAKE AND OHIO CANAL (survey for extension). (See also *Monongahela* and *Youghiogheny rivers; Transportation Routes to the Seaboard.*)

**Appropriations.**

| | |
|---|---|
| 1873, | [a]$5,000 |
| 1874, | [b]10,000 |
| Total, | 15,000 |

**Commerce.**

Important, **74**, 512, 547.

Tax on coal by railroad and possible saving by canal, **74**, 512. Coal fields of Pennsylvania, capacity of, **74**, 547.

Dimensions of boats on Chesapeake and Ohio Canal, **74**, 535. Effect of small tunnel sections on traffic and transit, **76**, ii, 79.

Rate of travel on canals, **74**, 535. Steam power must finally be used, **76**, ii, 81.

Coal and iron interests desire slack-water navigation to Connellsville, **76**, ii, 84.

Local extension of canal from Cumberland via north branch of Potomac to Savage River justified by value of coal interest, **74**, 544; **76**, ii, 88.

Comparison with third subdivision (central route) of transportation routes to the seaboard, **77**, 678.

**Engineers.**

Chief of Engineers. Reports, **73**, 60; **74**, 67; **75**, 73; **76**, 90.

Board of Engineers. "Board of internal improvement," 1826. Discussion of routes examined between the North Branch of the Potomac River and the Ohio at Pittsburg, **74**, 514. Consideration of Savage River and Deep Creek route, **74**, 516, 528. Of continuation via valleys of Youghiogheny and Monongahela rivers, **74**, 525. Of a passage of the Alleghanies, via Wills Creek route, **74**, 524, 529, 537. Comparison of, with Savage River route, **74**, 532, 533. Adoption of Wills Creek route, **74**, 474, 531, 533. Attempt to deflect line from valley of Youghiogheny at Briery Mountain, **74**, 525, 526. Inadmissible, **74**, 533,

Location of line from tide water on the Potomac to Pittsburg (341 miles), **74**, 536. Discussion of canal sections and estimates (see *Plans*), **74**, 534. Cost, $22,375,427, **74**, 543. Division of line into eastern, middle, and western sections, **74**, 513. Final conclusion and recommendation that route and general plan (see *Projects*) be adopted for western and eastern sections, submitting expediency of making surveys, and investigations as to comparative merits of railroad or canal for middle section, **74**, 543.

Consideration of a subdivision of eastern section, to wit, from mouth of Savage River to Cumberland, for the purpose of reaching coal fields at Savage River, **74**, 544.

(Col. Barnard and Maj. Totten. Capt. Poussin and W. Howard, assistants to board.)

Engineer in Charge. Maj. W. E. Merrill, 1874–76. Reports, **74**, 493, 550; **75**, 769; **76**, ii, 58.

Assistants:

T. S. Sedgwick (in charge of surveys), **74**, 493; **75**, 770; **76**, ii, 59. Reports, **74**, 500, 550; **76**, ii, 90.

C. L. Fulton, **74**, 502.

F. W. Frost, **74**, 502.

**Estimates.** (See *Plans* and *Projects.*)

By board of internal improvement, 1826, for canal from Georgetown (Potomac River) to Pittsburg (Ohio River); from Georgetown to Cumberland (now built), $8,177,081; from Cumberland to Castleman River (Wills Creek route), $10,028,123; from Castleman River to Pittsburg, $4,170,224; total, $22,375,428, **74**, 503, 543.

*Note.*—From Cumberland to Connellsville, $11,543,559, **74**, 511. Revision of estimates by board of civil engineers (1826), reducing estimate of eastern section (Georgetown to Cumberland) to $4,330,992. Afterwards built, and cost, with modifications, $11,071,176, **74**, 504.

Preliminary estimate of T. S. Sedgwick, 1874, Cumberland (via Savage River route) to Connellsville, $20,268,085, **74**, 507, 510; increased by Maj. Merrill to $23,133,585, by extending terminus of canal to McKeesport, **74**, 497; if inclined planes be used at designated points, **74**, 553, the estimate would be reduced $2,246,279, **74**, 554.

Revision of foregoing by Maj. Merrill, increasing canal section to that of present Chesapeake and Ohio Canal, $28,801,313, **74**, 498. Final estimate (1875) of recommended route from Cumberland, via Wills Creek and Castleman River and Youghiogheny River, to Connellsville, thence by slack-water navigation to McKeesport (mouth of Youghiogheny).

Canal proper, as per T. S. Sedgwick, $21,176,795, **76**, ii, 88, 102, 114, Summit reservoir (approximately), $600,000, **76**, ii, 87, 88; additional cost of inclined planes, $1,134,000, **76**, ii, 82, 88; additional cost of new terminus, Connellsville, $75,245, **76**, ii, 86, 88; total cost to Connellsville, $22,986,040, **76**, ii, 88; add slack-water navigation from Connellsville to McKeesport, $1,254,040, **76**, ii, 87, 88; grand total, $24,240,080.

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[a] (Exploration), 74, 493.

[b] Allotment, continuation of survey, 75, 73; 76, ii, 59.

**CHESAPEAKE AND OHIO CANAL**—Continued.

By board of internal improvement, 1826, for local extension of Chesapeake and Ohio Canal, Cumberland to mouth of Savage River (via north branch of Potomac), $1,794,964, **74**, 544.

By T. S. Sedgwick, 1875, same route, $2,656,558, **76**, ii, 89, 123; if to mouth of Georges Creek (omitting upper 2 miles of foregoing), $2,238,244, **76**, ii, 89.

Of cost of completing detailed surveys, $20,000, **75**, 771.

**Physical characteristics.**

Divide between north branch of Potomac River and Monongahela River, **74**, 494, 500, 513, 545.

Savage River and tributaries, discharge of, **74**, 519; elevation of points on, **74**, 494; **76**, ii, 123.

North branch of Potomac River, elevation of; headwaters of, **74**, 495, 502; **76**, ii, 123; rate of descent, **74**, 502.

Monongahela River, **74**, 525.

Youghiogheny River, elevation of points on, **74**, 521; **76**, ii, 86, 114; of the Narrows (Pyle Falls), **76**, ii, 83.

Distances from tide water (Potomac) to Pittsburg, **74**, 527.

Distances and elevations of points on proposed extension, **76**, ii, 114, 123.

Rainfall of valley of Ohio and tributaries, **74**, 507, 520, 523, 532; **76**, ii, 100; ratio collectible, **74**, 507, 532, 538; **76**, ii, 100.

Geological strata pierced by summit tunnel, **74**, 511.

Quantity of coal in basin traversed by proposed canal, **74**, 512; geological report on Somerset coal basin, **74**, 545.

**Plans.** (See *Estimates* and *Projects*.)

By board of internal improvement, 1825, for canal (in passage of Allegheny Mountains) from mouth of Savage River (north branch of Potomac) via Crabtree Creek and Deep Creek, to Youghiogheny River, part of a general project to connect tide water of Potomac with Ohio River, **74**, 494; discussion and consideration of, **74**, 513; length of summit tunnel, 1.33 miles, **74**, 494, 518, 528; distance, 41 miles; lockage, 2,388 f., **74**, 524, 529; summit level to be supplied by reservoirs, **74**, 522.

In 1826 a better crossing of the Allegheny Mountains was determined, via Wills Creek and Castleman River (see *Projects*), causing the abandonment of Savage River and Deep Creek route, **74**, 494, 500, 529.

By T. S. Sedgwick, 1874, for extending Chesapeake and Ohio Canal from Cumberland, via north branch of the Potomac, Savage River, and Blue Lick, thence by tunnel to Castleman River, thence following Castleman and Youghiogheny Rivers to Connellsville, **74**, 494, 496, 500, 510; length of canal, 127½ miles, **74**, 510; of summit tunnel, 5 miles, **74**, 494, 497, 505, 509; dimensions of, **74**, 509; summit level supplied from Castleman River, **74**, 504, 506, 510; section of canal 48 f. by 33 f. by 5 f.; dimension of locks 100 f. by 15 f. by 8 f., **74**, 498, 504, 507; at designated places subsequent consideration suggested use of inclined planes in place of locks (see *Projects*), **74**, 498, 550; estimated cost of plan $20,268,085, **74**, 510; revised by Maj. Merrill, **74**, 498; modified by proposed use of inclined planes, **74**, 554.

MEMORANDA in connection with plans.

Difficulty of maintaining sufficient water supply on short levels, **74**, 453, 495.

Consideration of water supply and amount required, **74**, 504, 505, 507, 520, 538; **76**, ii, 60, 63, 67, 73, 97.

Loss by evaporation, filtration, and leakage, **74**, 505, 507, 520; **76**, ii, 60, 65, 67, 73, 97.

Distance between locks, **74**, 495, 553.

Protection of slopes by surf berms, **74**, 534.

Discussion of canal section, relation between canal section and boats, and cost of towing, **74**, 534, 535, 536; **76**, ii, 80.

Equation of lockage to level line, **74**, 536, 556, 558; **77**, 681.

Determination of lock dimensions, **74**, 536.

Inclined planes, use of, in place of locks, **74**, 550; **76**, ii, 82, 100.

Lockage, time required for, **74**, 536, 556.

Canal tunnels, **74**, 493, 509, 549; **76**, ii, 79, 81, 124. Method of transit through, **74**, 493; **76**, ii, 79. Effects of small tunnels on transit and traffic, **76**, ii, 79.

Summit reservoirs and feeders, **76**, ii, 89.

Method of making canal water tight, **76**, ii, 74.

**Private (corporate) work.**

Chesapeake and Ohio Canal. (See *Board of Engineers* and *Projects*.) A scheme of Gen. Washington, **74**, 493. Projected by board of internal improvement (1825), **74**, 513. Constructed (1850), with modifications, from Georgetown to Cumberland (185 miles), **74**, 504, 513, 543. Dimensions of canal section and locks, **74**, 504. Cost, $11,071,176, **74**, 504.

**Projects.** (See *Estimates* and *Plans*.)

By "board of internal improvement," 1825, for canal from tide water on the Potomac River to the Ohio River, as follows: Eastern section, from Georgetown (on Potomac River) to Cumberland, on north branch of Potomac, 185 miles, **74**,

## CHESAPEAKE AND OHIO CANAL—Continued.

513. Middle section, from Cumberland (via Wills and Flaughertys creeks) to mouth of Castleman River, 70.5 miles; lockage, 1,368 f., **74**, 494, 536. Western section, from mouth of Castleman River (via valleys of Youghiogheny and Monongahela rivers) to Pittsburg, 85.25 miles; lockage, 619 f., **74**, 543. Section of canal, 48 f. by 33 f. by 5 f.; surf-berms, 2 f. wide; towpath, 9 f. wide; guard bank, 5 f. wide and 2 f. above water surface, **74**, 534; locks, 102 f. by 14 f. by 5 f., with an average lift of 8 f., **74**, 536; summit level, with tunnel 4½ miles long, 22 f. wide, 23½ f. high, **74**, 537; supplied by reservoirs on Castleman River, **74**, 531, 537; estimated cost of project (see *Estimates*), $22,375,429, **74**, 543.

Board of Engineers recommended the omission of middle section until further surveys and investigation should determine the relative merits of canal or railroad for, **74**, 543.

By Maj. Merrill, 1875, for extending Chesapeake and Ohio Canal to connect with navigable tributaries of Ohio River, beginning at Cumberland (present terminus of Chesapeake and Ohio Canal); thence via Wills Creek (28.43 miles) and summit level (6 miles) and valleys of Flaughertys Creek and Castleman River to Youghiogheny River (31.28 miles); thence by valley of the Youghiogheny (28.48 miles) to terminus of proposed canal, below Connellsville; thence by slack-water navigation (44.3 miles) to McKeesport, **74**, 494, 497, 500, 529, 558; **75**, 770; **76**, ii, 59, 83, 90, 101, 113. Canal section 70 f. wide, 7 f. deep, **76**, ii, 59, 92; except at designated points, **76**, ii, 59, 92; locks 120 f. by 20 f., **76**, ii, 59, 92. On the heaviest grades locks to be replaced by inclined planes, **74**, 498, 550; **75**, 770; **76**, ii, 82, 95, 101. Summit to be passed by tunnel (3¾ miles long) with section 26 f. by 42 f., **76**, ii, 78, 81, 92, 102, 103, 124; without towpaths, and to be worked by steam, **74**, 498, 511; **76**, ii, 81, 102; summit level to be fed by reservoirs, **74**, 504, 521; **76**, ii, 87, 99. Slack-water navigation on Youghiogheny River by means of 15 locks and dams, upper (12) locks 146 f. by 26 f., lower (3), 250 f. by 56 f., dams to be of stone, **74**, 558, 497; **76**, ii, 84, 86, 92. Estimated cost of project, $24,240,080, **76**, ii, 88.

For local extension of Chesapeake and Ohio Canal via north branch of Potomac River to mouth of Savage River, proposed by "board of internal improvement" (1826), 30.2 miles; lockage, 312 f., **74**, 544; dimensions same as main line, **74**, 534, 544; estimate, $1,794,963, **74**, 544.

For same route, Maj. Merrill, 1874, 30½ miles; lockage, 353 f.; canal section, 62 f. by 32 f. by 6 f.; locks, 100 f. by 15 f., **76**, ii, 89, 116. Estimate, $2,656,558, **76**, ii, 89, 123.

### Surveys.

Ordered for exploration of routes for extension of Chesapeake and Ohio Canal, Mar., 1873, **73**, 60; **74**, 67, 493; **76**, ii, 58.

History of early surveys, **74**, 493, 502, 513; **76**, ii, 90. Surveys of 1873–75 restricted to north branch of the Potomac, reason for, **74**, 493.

Routes surveyed, **74**, 494, 496; **76**, ii, 90, 115.

Line definitely located (1875) from Cumberland to near Ohio Pyle Falls, **75**, 770; **76**, ii, 91.

Additional (1876) surveys required, **76**, ii, 89.

## CHESAPEAKE BAY. (See *Charleston Harbor, S. C.; Croatan Sound, N. C.; Dismal Swamp Canal, Va. and N. C.; Pamlico Sound, N. C.; Pasquotank River, N. C.; Susquehanna River, Pa.; Winyah Bay, S. C.*)

## CHESAPEAKE BAY (Headwaters of) AND HAVRE DE GRACE HARBOR, MD.[a] (See also *Delaware and Chesapeake Canal.*)

### Appropriation.[b]

July 4, 1836, $500 (survey).

## CHESAPEAKE BAY TO CHARLESTON, S. C. (via Dismal Swamp Canal, Pasquotank River, Croatan, Pamlico, and other sounds, to Winyah Bay).[c] (See *Pasquotank River, N. C.*)

### Appropriation.

Act Mar. 3, 1837, $10,000 (surveys).

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[a] Surveys—Report, Jan. 30, 1837; estimate, $58,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Survey pursuant to resolution of the Maryland legislature. (Treasury Doc. 373, 1882.)

[c] Survey—Report, May 21, 1838. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CHESAPEAKE BAY TO LAKE ONTARIO.

**Survey.**
**67**, 17.

## CHESAPEAKE TO DELAWARE (BAYS) (Ship-canal surveys).

**Appropriations.**

1879, $16,000, **79**, 590 (allotments).
1881, 10,000, act Mar. 3.
1882, 10,000, **82**, 144 (survey).
1894, 5,000, act Aug. 18.

Total, 41,000

**Commerce.**

**72**, 702, 707.

Saving in time and distance by canal, **80**, 715.

Commerce passing through Delaware and Chesapeake Canal, **82**, 958.

Importance of the improvement, **83**, 742.

Commerce that would probably be benefited by construction of a large ship canal connecting the Chesapeake with Delaware Bay, **95**, 1198.

**Engineers.**

Chief of Engineers. Reports, **72**, 71; **78**, 69; **79**, 81; **80**, 110; **81**, 150; **82**, 144; **83**, 148, 725; **95**, 156.

Board of Engineers:

Congress, 1894, authorized the President to appoint a board to examine and determine, from surveys already made by the War Department, the most feasible route for a ship canal from Chesapeake Bay to Delaware Bay. Report, **95**, 1195.

(The Board met in Washington on Nov. 1, 1894, and was composed of Brig. Gen. T. L. Casey, Chief of Engineers, U. S. Army; Col. W. P. Craighill, Corps of Engineers; Capt. G. Dewey, U. S. Navy; Mendes Cohen, Maryland, and E. Porter Alexander, South Carolina.)

Engineer in Charge. Maj. W. P. Craighill. Reports, **72**, 701; **79**, 587; **80**, 713; (Lt. Col.), **82**, 950; **83**, 726, 749.

Assistants:

N. H. Hutton. Reports, **79**, 590; **80**, 717.

Capt. T. Turtle. Reports, **82**, 950; **83**, 727, 752.

M. Paret. Report, **83**, 727.

**Operations.**

**1878.** Field work and preparation of maps in progress, **79**, 590.

**Physical characteristics.**

Description, **72**, 702; **79**, 588, 589.

Geological formation of peninsula, **80**, 717.

Tidal observations, **80**, 729.

Ice records in Chesapeake and Delaware bays, **80**, 734; **82**, 954, 959; **83**, 744.

Results of borings, **83**, 728.

Table giving the several routes considered, **95**, 1197. The line of the existing Delaware & Chesapeake Canal thought by the Board to be the best adapted for defense and for giving facilities to commerce, **95**, 1199.

**Plans.**

By Maj. Craighill, 1872, survey, $20,000, **72**, 702; **79**, 590.

By Maj. Craighill, 1879, canal 100 f. at bottom, 26 f. deep, by Ferry Creek route, $16,250,000; by Queenstown route, $34,000,000; by Sassafras River route, $8,250,000, and $150,000 additional for each for right of way, **79**, 589.

By Lt. Col. Craighill, 1879, ship canal 26 f. deep at mean low water, 100 f. wide at bottom, and 178 f. wide at water line, without locks, except tide locks. The following locations were presented:

Choptank route, canal proper, 37.7 miles; estimate, $16,500,000, **80**, 715, 725.

Wye route, canal, 43 miles; estimate, $26,333,000, **80**, 715, 725.

Queenstown route, canal, 53.8 miles; estimate, $37,225,000, **80**, 715, 725.

Centerville route, canal, 51 miles; estimate, $41,500,000, **80**, 715, 725.

Southeast Creek route, canal, 38⅜ miles; estimate, $25,000,000, **80**, 715, 726.

Sassafras route, canal, 16¼ miles; estimate, $8,500,000, **80**, 715, 726, 735, 736.

Additional consideration of Choptank and Sassafras routes, **82**, 951.

In 1883, after additional examination and increasing the depth of the canal to 27 f., the following estimates were presented:

Choptank route, $18,184,766, **83**, 741;
Sassafras route, $11,410,000, **83**, 742;
Buck Creek route, $7,605,471, **83**, 742.

Maintenance of canal, **83**, 747.

**Private (corporate) work.**

Description of canal, **80**, 713; **82**, 957.

Protests of the Maryland & Delaware Ship Canal Co. against further surveys, **83**, 751, 753, 761.

Specifications of the Maryland & Delaware Ship Canal, **83**, 758.

**Surveys.** (See *Boards*.)

By N. H. Hutton, 1878, under direction of Maj. Craighill. Report, **79**, 587.

Previous surveys made, **80**, 714; **83**, 753.

Maps. **80**, 716; **83**, 742.

## CHESTER AND RIDLEY CREEKS, PA. (See *Ridley Creek, Pa.*)

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $3,000, | **81**, 793. |
| 1882, | 3,000, | **82**, 777. |
| Total, | 6,000 | |

**Contracts.**

**1882,** F. C. Somers, dredging, 52 cents per c. y., **83**, 634.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 97; **81**, 125; **82**, 123; **83**, 124.

ENGINEERS IN CHARGE:

Col. J. N. Macomb, 1880–82. Reports, **81**, 792, 793.

Capt. W. Ludlow, 1882–83. Report, **82**, 777.

Lt. Col. G. Weitzel, 1883. Report, **83**, 633.

ASSISTANT. T. G. Locke. Report, **83**, 634.

**Operations.**

**1882–83.** 10,613 c. y. dredged; project completed, **83**, 634.

**Projects.**

By Col. Macomb, 1881, for improving Chester Creek, dredging and removing silt to a depth of 7 f. low water at the entrance, diminishing upward; estimate, $10,781, **81**, 125, 794.

By request of city authorities dredging was confined to area between Second Street Bridge and mouth of creek, **83**, 634; completed, 1883, **83**, 634.

**Survey.**

Of Chester and Ridley creeks, near their outlets into the Delaware, ordered by act of Mar. 3, 1879, made, 1880, under the direction of Col. Macomb, **81**, 792.

## CHESTER HARBOR, PA. (See *Delaware River, Pa. and N. J.*, and *Reedy Island Harbor.*)

**Appropriations.**

| | | |
|---|---|---|
| 1826, | $100.00, | act May 20 (survey). |
| 1827, | 5,383.40 | **66**, iii, 31. |
| 1836, | 3,000.00 | |
| 1837, | 2,000.00 | |
| 1852, | 5,000.00, | **66**, 7, iii, 31. |
| 1867, | 11,000.00, | act Mar. 2. |
| 1873, | 550.00, | **73**, 864 (allotment). |
| 1876, | 2,600.00, | **76**, 59; **77**, 54, 262. |
| 1878, | 3,400.00, | **78**, 60, 437. |
| Total, | 33,033.40 | |

**Contracts.**

**1867.** B. Booth, materials, **67**, 439. J. R. Grant, materials, **67**, 439. J. Nelson, labor, **67**, 439.

**1868.** J. E. Neall, materials, **68**, 702. P. McAdams, materials, **68**, 702. H. Bitting, labor, **68**, 702.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7, ii, 41, iii, 22; **67**, 43; **68**, 63; **70**, 32; **71**, 81; **73**, 80; **75**, 97, 169; **76**, 59; **77**, 54; **78**, 60; **79**, 72; **80**, 94; **81**, 121; **82**, 120; **83**, 119, **84**, 128.

ENGINEERS IN CHARGE:

Lt. Col. C. S. Stewart, 1866–68. **66**, ii, 41, iii, 22. Reports, **66**, iv, 224; **67**, 437; **68**, 700.

Lt. Col. J. D. Kurtz, 1870–77. **70**, 71. Reports, **71**, 705; **73**, 864; **75**, ii, 183; **76**, 271; **77**, 262.

Col. J. N. Macomb, 1877–82. Reports, **78**, 437; **79**, 443; **80**, 584, 611; **81**, 767.

Capt. W. Ludlow, 1882–83. Report, **82**, 755.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 617.

Maj. W. H. Heuer, 1884. Report, **84**, 816.

ASSISTANTS:

E. Hergesheimer, **66**, iv, 224.

T. Valentine. Reports, **75**, ii, 185; **78**, 437; **79**, 443.

Capt. W. Ludlow. Report, **80**, 612.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Col. Stewart, entire completion of repairs, $11,000, **66**, iii, 22. In detail, **66**, iv, 225, 226. For renewal and general repairs in ten years, $7,000, **68**, 701.

By Lt. Col. Kurtz, aggregate for a new harbor, $123,000, **71**, 706. Repairs, $6,000, **75**, ii, 183; **76**, 271.

By T. Valentine, repairs, $3,153.60, **75**, ii, 186.

**Legislation.**

Recommended by Lt. Col. Stewart that the United States might retrocede the piers to the State, **67**, 438.

**Operations.**

**1866–67.** Repairs in progress, **67**, 43.

**1867–68.** Repairs completed, details, **68**, 63, 700.

**1872–73.** Repairs to piers and bridges to the amount of $550, **73**, 864.

**1876–77.** Repairs to piers and bridges by hired labor to the amount of $2,600, **77**, 54, 262.

**1878–79.** Repairs, and construction of a new connecting bridge; **79**, 72, 443.

**Physical characteristics.**

Description, **66**, iv, 224; **68**, 701, **71**, 706; **75**, ii, 184.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Col. Kurtz to abandon the old harbor and establish one above the city, composed of six piers, **71**, 706.

## CHESTER HARBOR, PA.—Continued.

**Private, corporate, and State work.**

The original piers and wharves were ceded to the U. S. by the State of Pennsylvania, **75**, ii, 186.

Private wharves built between the Government piers, **67**, 438.

Proposed occupancy of lower pier by the Chester & Delaware River R. R. Co., **75**, ii, 184, 186.

**Projects.** (See *Estimates* and *Plans.*)

Original, for harbor of refuge against floating ice, **66**, iv, 224, 226.

By Maj. Stewart, repairs, details, **66**, iv, 225, 226.

By Lt. Col. Kurtz, repairs to piers and bulkhead, and reconstruction of bridges, **77**, 262.

**Surveys.**

Assigned to Maj. Stewart, **66**, ii, 41. Made in Sept. and Oct., 1865, **66**, iii, 22, by E. Hergesheimer. Reports, **66**, iv, 224.

Ordered by act approved July 11, 1870, **70**, 31, 32; examination made by Lt. Col. Kurtz. Report, **71**, 705.

Examination or survey ordered by act approved Mar. 3, 1875, of lower pier, **75**, 169; made under direction of Lt. Col. Kurtz, by T. Valentine. Reports, **75**, ii, 184, 185.

Ordered by act approved Mar. 3, 1879, and assigned to Col. Macomb, **79**, 72, 443.

Examination for ice harbor at Marcus Hook and Chester ordered by act of Mar. 3, 1879, made, 1880, under direction of Col. Macomb, **80**, 611.

MAPS. Plan of the ice harbor, **79**, 443.

## CHESTER PIERS. (See *Delaware River.*)

## CHESTER RIVER, MD.

**Appropriations.**

| | | |
|---|---|---|
| 1873, | $15,000, | **73**, 72, 77, 760; **74**, 81; **75**, ii, 64. |
| 1874, | 5,000, | **74**, 81, ii, 17; **75**, 85, ii, 64. |
| 1876, | 5,000, | **76**, 62, 63, 284; **77**, 56, 273. |
| 1878, | 3,000, | **78**, 64, 447. |
| 1881, | 6,500, | **86**, 866. |
| 1882, | 6,500, | **82**, 841. |
| 1890, | 5,000, | **90**, 954. |
| 1892, | 3,000, | **92**, 971. |
| 1894, | 1,500, | **95**, 1128. |
| 1896, | 1,500, | **96**, 959. |
| 1899, | 3,200, | **99**, 1383. |
| Total, | 55,200 | |

**Contracts.**

**1875.** W. H. Beard, dredging, 16⅞ cents per c. y., **75**, 86, ii, 64; **76**, 283, 284.

**1881.** D. Constantine, dredging, 27 cents per c. y., **82**, 841.

**1891.** National Dredging Co., dredging, 10 cents per c. y., **91**, 1189.

**1892.** American Dredging Co., dredging, 15 cents per c. y., s. m., **93**, 1212.

**1895.** Baltimore Dredging Co., dredging, 19.8 cents per c. y., p. m., **95**, 1129.

**1896.** C. T. Caler, dredging, 9.5 cents per c. y., p. m., **97**, 1274.

**1899.** Baltimore Dredging Co., dredging, 12.4 cents per c. y., p. m., **1900**, 1646.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **72**, 74; **73**, 71, 77; **74**, 81; **75**, 85; **76**, 62; **77**, 56; **78**, 63; **79**, 75; **80**, 100, 111; **81**, 132, 150; **82**, 129, 130; **83**, 133, 134; **84**, 141; **85**, 133; **86**, 130; **87**, 93; **89**, 112; **90**, 102; **91**, 126; **92**, 126; **93**, 136; **94**, 125; **95**, 142; **96**, 129; **97**, 164; **98**, 167; **99**, 193; **1900**, 219.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1872–84; **72**, 74. Reports, **73**, 760, 817–819, 825; **74**, ii, 17; **75**, ii, 64; **76**, 283; **77**, 271; **79**, 489; **80**, 624; (Lt. Col.) **81**, 839, 856; **82**, 841, 843; **83**, 667, 669; **84**, 893.

Capt. C. B. Phillips, 1878, in temporary charge. Report, **78**, 445.

W. F. Smith, U. S. Agent, 1884–. Reports, **85**, 884; **86**, 866; **87**, 838; **88**, 747; (map) **90**, 954; **91**, 1188; **92**, 970; **93**, 1211; **94**, 889; **95**, 1128; **96**, 958; **97**, 1273; **98**, 1159; **99**, 1383; **1900**, 1645.

ASSISTANTS:

W. Popp. Reports, **73**, 818, 826.

H. Bacon. Reports, **75**, ii, 64; **81**, 856.

Capt. C. B. Phillips. Reports, **76**, 284; **77**, 273.

A. Stierle. Report, **90**, 955.

**Estimates.** (See *Projects.*)

By W. Popp, adopted by Maj. Craighill, dredging a 7-f. channel through causeway, $23,100; dredging a 6-f. channel, $15,000, **73**, 760, 817, 818, 825; **74**, ii, 17. For 7-f. channel, increased to $25,000 by Maj. Craighill on account of long delays in operations, **75**, 86, ii, 64; **76**, 63, 284. Additional increase of $3,000 for same cause, **77**, 57, 273.

**Legislation.**

Maryland, by act approved April 11, 1874, consented to the removal of the causeway, with the proviso "that before said causeway should be cut or opened

## CHESTER RIVER, MD.—Continued.

there shall be built a bridge with a draw of not less than 60 f.," **74**, 81, ii, 17.

**Operations.**

History of, **75**, ii, 64; **76**, 283; **77**, 271.

Deferred until a bridge was built, **74**, 81, ii, 17.

**1874–75.** Dredging by contract in progress, **75**, 86, ii, 64; about 10,000 c. y. removed, **76**, 283.

**1875–76.** Dredging continued; about 88,000 c. y. removed, **76**, 62, 63, 284.

**1876–77.** Dredging under contract ceased July 7, 1876, the available funds being exhausted; additional vent through the causeway was given; four pile-wings constructed; channel defined by guide-piles; some riprapping done, and, June 28, 1877, a dredge chartered by the day to dredge at the sharp turns in the channel, **77**, 57, 272, 273.

**1877–78.** 10,970 c. y. removed by dredging, **78**, 446.

**1881–82.** Channel over shoals dredged 70 f. wide and 8 f. deep at low water, **82**, 841.

**1882–83.** Channel widened to 120 f. and project completed as originally proposed, **83**, 133; **86**, 130.

**1890–91.** Excavation of channel begun under contract, **91**, 1788.

**1891–92.** 20,061 c. y. dredged, **92**, 971.

**1892–93.** 26,734 c. y., p. m., dredged, **93**, 1211.

**1895–96.** 5,502 c. y., p. m., dredged, **96**, 959.

**1898–99.** 10,483 c. y., p. m., dredged, **99**, 1383.

**1899–1900.** 20,090 c. y., p. m., dredged, **1900**, 1645.

**Physical characteristics.**

Description of, **73**, 817–819, 827; **75**, ii, 65.

**Private (county and private) work.**

A solid causeway was built across the "Narrows" about 1820 by Queen Anns County; also a tide mill and race was constructed, to the injury of the channel, **73**, 817–819, 826; drawbridge built by the county authorities at the causeway, **76**, 283; repairs made to the causeway and draw by the county authorities, **77**, 57, 272.

**Projects.**

Making an opening through the causeway, and dredging a channel 100 f. by 7 f., **75**, ii, 64; **76**, 283; **77**, 271.

By Maj. Craighill, 1874, reopening a channel formerly existing between Chester River and Eastern Bay, closed by a solid causeway, under the authority of the State of Maryland; estimate, $25,000, **75**, ii, 64; **85**, 133. Project completed, at a cost of $25,000, in 1878; no further work deemed necessary, **85**, 133.

By Maj. Craighill, 1881, Spry's Landing to Crompton, excavation of channel 120 f. wide and 8 f. deep at m. l. w. Estimate, $13,167. **81**, 857; **83**, 667. Project completed in 1883, **83**, 133; **86**, 130.

In 1889, Maj. Smith, Chester to Jones Landing, excavation of a channel, Crampton to a point 1 mile below Millington, supposed to be Jones Landing, 6¼ miles, 60 f. wide and 6 f. deep at m. l. w.; estimate, $12,750, **90**, 956; **91**, 1186; **92**, 971.

**Surveys.**

Ordered by act approved June 10, 1872, assigned to Maj. Craighill, **72**, 74, and made under his direction by W. Popp, in October, 1872. Reports, **73**, 817, 818, 825, 826.

Under direction of Maj. Craighill, 1877–78, **79**, 491.

Resurvey of channel, 1880, **80**, 624.

Kirby's to Spry's Landing, ordered by act of June 14, 1880, made 1881, under the direction of Maj. Craighill, **81**, 150, 856.

Survey, Crampton to Jones Landing, ordered by act of August 11, 1888, made, 1889, under direction of Maj. Smith, **90**, 956.

## CHETCO RIVER, OREG.

**Commerce.**

Inappreciable, **93**, 3430.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 444.

ENGINEER IN CHARGE. Capt. T. W. Symons, 1893. Report, **93**, 3429.

ASSISTANT. Lt. F. R. Shunk. Report, **93**, 3431.

**Physical characteristics.**

Small stream entering the Pacific Ocean about 3 miles north of the boundary line between Oregon and California, about 30 or 35 miles long; practically no tidal compartment, and its greatest width at the mouth 60 f., **93**, 3430.

**Survey.**

Examination ordered by act of July 13, 1892, made in the same year by Capt. Symons (report unfavorable), **93**, 3429.

## CHEVREUIL BAYOU AND BAYOU TIGRE, LA.

**Engineers.**
CHIEF OF ENGINEERS. Report, **91**, 229.
ENGINEER IN CHARGE. Capt. W. L. Fisk, 1891. Report, **91**, 1841.

**Physical characteristics.**
Description of, **91**, 1841.

**Survey.**
Examination ordered by act of September 19, 1890; made, 1891, under direction of Capt. Fisk (report unfavorable), **91**, 1841.

## CHEYENNE RIVER, S. DAK.

**Engineers.**
CHIEF OF ENGINEERS. Report, **80**, 170.
ENGINEER IN CHARGE. Lt. E. Maguire, 1880. Report, **80**, 1478.

**Survey.**
Of Cheyenne River, ordered by act of Mar. 3, 1879, **79**, 128; made 1880, under direction of Lt. Maguire (report unfavorable), **80**, 1478.
History of the work, **80**, 1479.

## CHICAGO. (See *Great Lakes.*)

## CHICAGO HARBOR, ILL.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1833, | $25,000, | **66**, iii, 35. |
| 1834, | 32,801, | **66**, iii, 35. |
| 1835, | 32,800, | **66**, iii, 35. |
| 1836, | 32,000, | **66**, iii, 35. |
| 1837, | 40,000, | **66**, iii, 35. |
| 1838, | 30,000, | **66**, iii, 35. |
| 1843–44, | 25,000, | **66**, iii, 35. |
| 1844, | 30,000, | **66**, iii, 35. |
| 1852, | 20,000, | **66**, iii, 35. |
| 1864, | 25,000, | **66**, 15, 16; iii, 35 (allotment). |
| 1866, | 88,704, | **66**, iii, 11, 35; iv, 91, 114. |
| 1868, | 35,000, | **68**, 31; **69**, 28 (allotment). |
| 1869, | 29,700, | **69**, 22 (allotment). |
| 1870,[b] | 100,000, | **70**, 37; **71**, 35. |
| 1871, | 100,000, | **71**, 35, 117. |
| 1872, | 90,000, | **72**, 34, 130. |
| 1873, | 90,000, | **73**, 35. |
| 1874, | 75,000, | **74**, 41, 156. |
| 1875, | 78,000, | **75**, 45, 231. |
| 1876, | 5,000, | **76**, 99; **77**, 103. |
| 1878, | 75,000, | **78**, 118, 1185. |
| 1879, | 75,000, | **79**, 157, 1560. |
| 1880, | 145,000, | **80**, 1986. |
| 1881, | 150,000, | **81**, 2160. |
| 1882, | 200,000, | **82**, 2206. |
| 1884, | 100,000, | **84**, 1945. |
| 1886, | 75,000, | **86**, 1703. |
| 1888, | 200,000, | **88**, 1888. |
| 1890, | 100,000, | **90**, 2402. |
| 1892, | 72,000, | **92**, 2239. |
| 1894, | [c] 80,000, | **95**, 2697. |
| 1899, | 100,000, | **99**, 2824. |
| Total, | 2,356,005 | |

**Commerce.** (See *Chicago River.*)
Requirements discussed, **79**, 1562.
Area of outer harbor, **82**, 2204; **83**, 1742; **84**, 1944.
Collisions with exterior breakwater, **83**, 1742; **84**, 1944.

**Contracts.**
**1866.** J. M. Corse, cribs and dredging, **66**, iv, 114; **67**, 58, 90, 91; **68**, 111.
**1870.** Illinois Central R. R. Co., labor and material, **70**, 99. Fox & Howard, breakwater, **71**, 117.
**1871.** Illinois Central R. R. Co., breakwater, **71**, 117.
**1873.** Fitzsimmons & Connell, breakwater, **73**, 213.
**1875.** W. L. Smith, extension of north pier, **76**, ii, 433. I. D. Vandecar, removal of wreck, **76**, ii, 433.
**1878.** Fitzsimmons & Connell, dredging, **79**, 1560.
**1879.** G. Hannahs, materials, **79**, 1560. G. Hannahs, timber and piles, **80**, 1984, 1986.
**1880.** Chicago Dredging & Dock Co., dredging, 21¼ cents per c. y., **81**, 2161.
**1881.** G. Hannahs, timber, **81**, 2161. Shumway, Bergess & Co., drift bolts, **81**, 2161.
**1882.** W. E. Hutchinson, timber, **82**, 2206. G. Hannahs, timber, **82**, 2206. Beckford, Knox & Co., timber, **82**, 2206.
**1883.** A. H. Petrie & Co., timber, **83**, 1745. A. S. Packard, timber, **83**, 1745. Green Bay Dredging Co., dredg-

[a] Surveys—Reports: Feb. 24, 1830, estimate $59,722.24; Dec. 31, 1855, estimate $138,516.68; Nov. 15, 1856, indefinite; Sept. 30, 1857, estimate $174,450.74; Nov. 15, 1858, $219,342.96; Aug. 2, 1864, estimate indefinite; June 30, 1865, estimate $88,604. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] $50,000 additional appropriated for harbor of refuge, Chicago, intended for and applied to improvement of mouth of Calumet River, **71**, 117.

[c] $25,000 to be used at the discretion of the Secretary of War to improve the river up to the forks.

**CHICAGO HARBOR, ILL.**—Continued.

ing, 17¾ cents per c. y., **83**, 1745. Singer & Talcott Stone Co., stone, **83**, 1745.

**1884.** Chicago Dredging & Dock Co., dredging 23½ cents per c. y., **85**, 2050. C. E. Mitchell, timber, **85**, 2050. Leatham & Smith, **85**, 2050.

**1888.** F. R. Crane, dredging, 13½ cents per c. y., **89**, 2112. The Fitzsimmons & Connell Co., breakwater construction, $118,117.87, **89**, 2112.

**1891.** Kimball & Cobb Stone Co., superstructure reconstruction, $85,335.38, **91**, 2599.

**1892.** Wisconsin Dredge & Dock Co., rebuilding superstructure (timber, ironwork, stone, piles, etc.), $37,856.77, **93**, 2801. Green's Dredging Co., dredging, 14 cents per c. y., $4,767.84, **93**, 2802.

**1894.** The Fitz Simons & Connell Co., rebuilding and repair of superstructure (pine timber, ironwork, stone, etc.), $56,528.16, **95**, 2698.

**1896.** Illinois Dredging Co., dredging, 14 cents per c. y., $2,800, **96**, 2576.

**1899.** Chicago Star Construction & Dredging Co., dredging, 7 cents; removing and furnishing piles, iron dredge chain, and stone (estimated total of contract, $73,788.70), **99**, 2825. Dredging annulled by supplementary contract (see *Legal proceedings*), **1900**, 3780.

**Documents.** (Not printed in reports.)

Reports of Maj. Graham for 1855–56, S. Doc. 16, 34th Cong., 3d sess. For 1857, S. Doc. 42, 35th Cong., 1st sess. Report of Lt. Col. Cram, dated Aug. 23, 1864, **66**, 16.

Letter of Maj. Houston, describing manner of sinking cribs, dated Oct. 28, 1874, **75**, 228.

**Engineers.**

Chief of Engineers. Reports, **66**, 5, ii, 37, 41, iii, 11, 35, iv, 110; **67**, 20, 23, 90, 252; **68**, 31; **69**, 22, 23, 28; **70**, 37; **71**, 35; **72**, 33, 159, 164, 170; **73**, 34; **74**, 40; **75**, 45; **76**, 98; **77**, 103; **78**, 117; **79**, 157; **80**, 210, 212; **81**, 285, 287, 2161; **82**, 280, 2209; **83**, 288; **84**, 289; **85**, 312; **86**, 306; **87**, 272; **88**, 247; **89**, 287; **90**, 257; **91**, 329, 426; **92**, 315; **93**, 359; **94**, 331; **95**, 368; **96**, 324; **97**, 409; **98**, 400; **99**, 474; **1900**, 540.

Boards of Engineers.

Convened at Chicago January 18, 1870. Made a personal examination of the harbor, and adjourned to meet at Milwaukee the following day, **71**, 123. Met pursuant to adjournment, and unanimously approved the plan submitted by Maj. Wheeler for a breakwater for an outer harbor. Report, **70**, 124. (Col. Macomb, Lt. Col. Raynolds, and Majs. Wheeler, Weitzel, and McFarland.)

Convened July 28, 1878. After full discussion, approved plan submitted by Capt. Lydecker for modifications in breakwater for outer harbor and construction of a breakwater north and east of the present north pier. Report, **79**, 1561. (Majs. Houston, Robert, Smith, and Mansfield, and Capt. Lydecker.)

Convened January, 1881, to examine and report on Maj. Lydecker's plan and location for exterior breakwater. Report, **81**, 2162. (Cols. Tower and Newton and Lt. Col. Abbott.) (See *Projects.*)

Constituted by S. O. No. 31, C. of E., 1882, to consider and report upon the plans submitted by Illinois Central R. R. for docks and wharves fronting the outer harbor. Report, **82**, 2234. Recommendations of board, **82**, 2237. (Lt. Cols. Parke and Comstock and Maj. Weitzel.)

Convened at Chicago, Sept. 17, 1890, by S. O. No. 61, to report upon the establishment of harbor lines in Chicago Harbor. Report, **91**, 2661. (Col. Poe, Maj. Davis, and Capt. Marshall.)

Engineers in Charge:

Lt. J. D. Webster, 1848–54. **76**, ii, 433.

Lt. Col. J. D. Graham, 1856–64. **76**, ii, 433.

Lt. Col. T. J. Cram, 1864. Reports, **66**, 12, 14, 24.

Lt. Col. L. Sitgreaves, 1865. **66**, 20, iv, 91.

Maj. J. B. Wheeler, 1866–70. Reports, **66**, iv, 91, 114; **67**, 55, 58, 86–92, 257; **68**, 79, 110; **69**, 73.

Special on plan for a breakwater for an outer harbor, **70**, 79.

Maj. W. E. Merrill, 1870, **70**, 99.

Maj. D. C. Houston, 1870–74. Reports, **70**, 89, 96; **71**, 117; **72**, 129; **73**, 215; **74**, 155.

Special, proposing modified cross section and stone foundations for cribs, **72**, 160, 165; notes on waive motion, etc., **72**, 168.

Maj. G. L. Gillespie, 1874–76. Reports, **75**, 228; **76**, ii, 426.

Capt. G. J. Lydecker, 1877–82. Reports, **77**, 893; **78**, 1183; **79**, 1555; (Maj.), **80**, 1983; **81**, 2151.

Special, Nov. 4, 1878, to president Board of Engineers, submitting modifications in plan of outer harbor and a breakwater north and east of the north pier, **79**, 1562.

Maj. W. H. H. Benyaurd, 1882–86. Reports, **82**, 2203, 2207; **83**, 1741; **84**, 1943; **85**, 2047; **86**, 1701.

Maj. T. Handbury, 1886–87. Report, **87**, 2109.

Capt. W. L. Marshall, 1888–99. Reports, **88**, 1886; **89**, 2110; **90**, 2399; **91**, 2596; **92**, 2237; **93**, 2791; **94**, 2127;

## CHICAGO HARBOR, ILL.—Continued.

(Maj.), **95**, 2693; **96**, 2571; **97**, 2790; **98**, 2415; **99**, 2821.

Maj. J. H. Willard, 1899–. Report, **1900**, 3779.

ASSISTANTS:

Lt. A. Mackenzie, **66**, iv, 91.

Capt. D. P. Heap. Reports, **67**, 86; **68**, 110.

W. T. Casgrain, **67**, 119.

E. S. Chesbrough, **70**, 99.

W. H. Hearding. Stone foundations for cribs, **72**, 161.

Lt. F. A. Hinman. Reports, **73**, 213; **74**, 155.

R. S. Littlefield. Report on extension of north pier, **73**, 214; **74**, 155.

J. Pierpont, **74**, 155.

J. C. Almy. Report, **89**, 2113.

G. A. M. Liljencrantz. Reports, **90**, 2402; **91**, 2599; **92**, 2240; **93**, 2802; **94**, 2131; **95**, 2698; **96**, 2577; **97**, 2792; **98**, 2418; **99**, 2825; **1900**, 3783.

Navigation of Chicago River, **93**, 2805.

**Estimates.** (See *Projects.*)

By Lt. Col. Graham, 1857, to complete the work, $174,450.74, S. Doc. 42, 35th Cong., 1st sess.

By Lt. Col. Cram, 1864, extension of both piers, $88,704, **66**, 5, 16, 24.

By Maj. Wheeler, extension of north pier, aggregate, $86,744.65; details for one crib, $4,572.35, **66**, iv, 115; 14-ft. channel, $2,500, **67**, 258, 259; extension of south pier, $48,000, **68**, 31; to complete the work, $45,000, **69**, 28, 73; enlargement of harbor facilities by a breakwater, $900,000, **70**, 102; **74**, 156.

By Maj. Houston, completion of south pier, $75,000, **70**, 96; extension of north pier, $78,000, **74**, 156.

By Maj. Gillespie, dredging, $5,000, **75**, 45, 230; aggregate for proposed improvements, $150,000, **76**, 99, ii, 431.

By Capt. Lydecker, completion of existing project, **77**, 894; $250,000, **78**, 1185; $600,000 additional to complete outer harbor as modified, and construct a breakwater north and east of north pier, 1 mile in length, **79**, 158, 1566.

**Legal proceedings.**

Encroachment of railroads upon area of outer harbor, **82**, 2207-2240; **87**, 2110.

The ownership and control of submerged lands in the outer basin decided to be in the State and the city, **95**, 2694.

Title to several slips and docks in possession of Illinois Central Railroad Co., **99**, 2822.

City of Chicago, 1899-1900, under old laws for the first time enforced, prevented all dumping in Lake Michigan within 8 miles of the shore line between the north limits of the city and the Indiana State line, thus violating an agreement to permit such dumping, and thereby compelling an annulment of contract for dredging, **1900**, 3780.

**Operations.** (See also *Private work.*)

History of, **76**, ii, 433; **79**, 1555. Suspended since 1852, **66**, 5.

**1866.** Delayed to enable the city to perform the work proposed, viz, extension of the north pier, **66**, ii, 37.

**1867.** Extension of north pier in progress, 11,628 f. of timber framed, **67**, 90.

**1868.** 96 f. of north pier extension completed, and 3,152 c. y. of dreding, **68**, 111.

**1869.** North pier completed, ending in 23 f. of water; extension of south pier 600 f. under contract and in progress, **69**, 28.

**1870.** South pier extension continued; built to water surface, a length of 1,224 f., **70**, 37, 96. Breakwater for outer harbor commenced, 256 l. f. built to water surface, **70**, 37.

**1871.** 29 cribs, equal to 1,450 l. f., placed in breakwater and completed to water surface, **71**, 35, 117.

**1872.** Extended 1,100 f., 2,250 l. f. completed to date, **72**, 33, 129.

**1873.** Extended 800 f., now 3,050 f. long, **73**, 34, 213.

**1874.** Extension of breakwater 1,100 f. and repairs, **74**, 40, 155.

**1875.** Breakwater extended 150 l. f., 1,400 f. of superstructure built, pile protection to north end of breakwater in progress, 100 f. added to north harbor pier, repairs to north and south harbor piers, and wreck removed, **75**, 45, 228, 229.

**1876.** By hired labor, 1,250 f. of superstructure for the breakwater, 1,000 f. of pile protection at the north end of breakwater, 2 cribs sunk in extension of north pier, and repairs to north and south piers; by contract, 10 cribs added to north-harbor pier and superstructure nearly completed over the entire extension of 600 f.; also, removal of a schooner wreck, **76**, 98, ii, 426.

**1877.** Superstructure over 600 f. of north pier completed and pile protection to pier head built, pile protection to breakwater extended 292 feet, and repairs, **77**, 103. 893.

**1878.** Slight repairs only, **78**, 1183.

**1879-80.** Breakwater extended 800 f. by hired labor, 88,758 c. y. dredged by contract, **79**, 157, 1556; 974 piles driven for crib foundation, 1,900 l. f. of crib-pier superstructure placed in extension of southerly breakwater, and 2,300 l. f. of superstructure built; undue settlement of last 4 cribs placed; work mainly done by hired labor and purchase in open market, **80**, 1984.

## CHICAGO HARBOR, ILL.—Continued.

**1880–81.** 87 piles driven for crib foundations, 300 l. f. of crib substructure and 1,100 l. f. superstructure placed in southerly breakwater, thereby completing the proposed southerly breakwater, with a length of 3,000 l. f., **81**, 2151; 72,158 c. y. dredged in outer harbor, **81**, 2152; **82**, 2204.

**1881–82.** 136,287 c. y. dredged from outer harbor, **82**, 2204; 1,536 l. f. of exterior breakwater built, **82**, 2204; **83**, 1742.

**1882–83.** 900 l. f. exterior breakwater built, **83**, 1742.

**1883–84.** 800 l. f. of exterior breakwater built and 100 l. f. repaired, **84**, 1944; 65,758 c. y. dredged from outer harbor, **84**, 1945.

**1884–85.** 700 l. f. of exterior breakwater built, including 100 l. f. destroyed in 1881, with extensive repairs to cribs, **85**, 2048; settlement of cribs, **85**, 2048; dredging in progress in outer harbor, **85**, 2049.

**1885–86.** Injury to southerly breakwater from gales, **86**, 1702.

**1886–87.** Repairs to breakwater, **87**, 2112.

**1887–88.** 95 l. f. of concrete superstructure laid; 400 l. f. of substructure laid in extension of the exterior breakwater, **88**, 1887.

**1888–89.** 400 l. f. superstructure built over outer extremity of exterior breakwater; substructure of exterior breakwater extended 408 f.; 4 cribs built to repair gap in southerly breakwater; 25,280 c. y. dredged, **89**, 2110.

**1889–90.** 748 l. f. substructure and 1,156 l. f. superstructure built at exterior breakwater; 5 cribs placed in southerly breakwater gap, **90**, 2399.

**1890–91.** 1,700 l. f. of east breakwater superstructure rebuilt, **91**, 2597.

**1891–92.** Superstructure over easterly breakwater completed; superstructure built over north pier and repairs made to the same, **92**, 2240.

**1892–93.** Over 3,000 f. of superstructure at outer basin in course of reconstruction, **93**, 2793; over 34,056 c. y. dredged from channel entrance to the harbor, **93**, 2794.

**1893–94.** Superstructure being rebuilt last year completed, **94**, 2129.

**1894–95.** Rebuilding of superstructure of exterior breakwater and repairs in progress, **95**, 2695.

**1895–96.** In connection with preceding year 2,200 l. f. of superstructure of exterior breakwater rebuilt, **96**, 2573.

**1897–98.** Miscellaneous repairs were made to piers at entrance by persons responsible for damage to the same, **98**, 2417.

**1899–1900.** Easterly and southerly breakwaters filled with stone, **1900**, 3780.

**Physical characteristics.**

Described, **66**, iv, 93, 114.

Gauge readings at Chicago River, **93**, 2805; **94**, 2137; **95**, 2579; **97**, 2793; **98**, 2421; **99**, 2826; **1900**, 3784.

**Private (city and corporate) work.**

**1864–65.** Good results obtained by work done by the city, **66**, 15.

$75,000 was appropriated by the city for dredging and pier extension; 437½ f. built in extension of the north pier, **66**, 15.

Improvements by Chicago Dock & Canal Co., **67**, 23, 86, 91, 92; **68**, 31, 110.

Encroachment of railroads on harbor areas, **82**, 2207.

Under authority of the Secretary of War, 1895, city constructed bulkhead along dock line and filled in the area shoreward of the bulkhead for a public park, **99**, 2822.

**Projects.** (See *Estimates.*)

By Lt. Col. Cram, repairs and extension of the north and south piers, **66**, 16; modified by Maj. Wheeler, giving increased width to the cribs, dredging and extending the north pier only, **66**, iv, 114; **67**, 86. Channel for vessels drawing 14 f. of water, **67**, 258, 259. Extension of the south harbor pier, **68**, 111; **69**, 28. Outer harbor, formed by a breakwater inclosing about 275 acres, **70**, 101; **74**, 156.

By Maj. Houston, modification of cross section of breakwater and stone foundations for the cribs, **72**, 33. Extension of the breakwater instead of building the pier, **72**, 129. Extension of the north harbor pier, **73**, 214.

By Maj. Gillespie, extension of the breakwater southerly 1,000 f., channel to connect the outer harbor with the river, and repairs, **76**, 99, ii, 431.

Board of Engineers approved and recommended adoption of project submitted by Capt. Lydecker for modifications in breakwater for outer harbor and construction of a new breakwater north and east of north pier, **79**, 1561, 1562.

The work for the improvement of this harbor was commenced by the United States under its first appropriation in 1833 and continued at irregular intervals to 1864, and thereafter more regularly to 1870. Between 1833 and 1870 the project consisted in the formation of a channel of entrance to mouth of river between two piers extending into the lake, and between which a channel of about 14 f.

## CHICAGO HARBOR, ILL.—Continued.

was obtained. The amount appropriated from 1833–69, inclusive, was $446,005, **76**, ii, 433; **79**, 1555. Between 1870 and 1876 additional extensions were made to the north and south piers, **70**, 96; **76**, ii, 426, 435. In 1870 the project for an outer harbor was adopted, contemplating the construction of an easterly breakwater 4,000 f. long, about 3,300 f. from the shore, and a southeasterly breakwater about 3,000 f. long, the protected area being about 455 acres, of which 185 acres were reserved for piers and slips, and 270 acres, with a depth dredged to 16 f., for harborage, **70**, 101, 124; **76**, ii, 435; **79**, 1555; **86**, 1702.

In 1878 the project was further modified by an additional breakwater about 5,400 f. long, and to be placed north and east of the harbor entrance, **79**, 1561; **81**, 2153, 2162; **86**, 306. The amount appropriated from 1870–86, inclusive, was $1,358,000, and in 1886 it was estimated that $240,000 was required to complete existing project, **86**, 1703; **87**, 2113.

In 1888 the estimate for completion of existing project, including superstructure construction over easterly breakwater in the outer harbor, completion of exterior breakwater and outer basin, and dredging at the harbor entrance, was increased to $372,000, **88**, 1887; **91**, 2599.

By Capt. Marshall, 1893, for rebuilding superstructures over the piers in the outer basin, cost to be paid from part of the 1892 appropriation, **93**, 2793, and for dredging the channel entrance to Chicago River to a width varying from 200 to 250 f., and to a depth of 16½ f., **93**, 2794.

Act of Mar. 3, 1899, modified project of 1870 by providing for dredging an outer basin and harbor entrance to 20 f. depth, l. w., **99**, 2822.

**Surveys.**

Under direction of Lt. Col. Graham, 1858, **70**, 99.

Under direction of Lt. Col. Cram, 1865, **66**, 16.

Under direction of Col. Raynolds, 1865, **67**, 119; by Mr. Chesbrough, **70**, 99.

Under direction of Maj. Wheeler, 1869, **70**, 99.

Under direction of Lt. Hinman, by J. Pierpont and R. S. Littlefield, 1873, **74**, 155.

Under direction of Maj. Gillespie, **76**, 98; ii, 428.

Under direction of Capt. Lydecker, 1878, **79**, 1566.

Of Chicago River and north and south branches ordered by act of June 14, 1880, **80**, 212.

Survey of harbor made 1882, **83**, 1743.

Survey of the harbor and its approaches made, 1892–93, by Capt. Marshall, **93**, 2794.

MAPS.

**66**, **78**, 1184; **80**, 1984; **81**, 2158; **82**, 2206; **83**, 1744; **84**, 1944; **85**, 2050; **86**, 1702; **87**, 2112; **90**, 2402; **91**, 2599; **92**, Atlas, 104; **94**, 2134; **95**, 2700; **96**, 2578; **98**, 2418.

Sketch of the harbor, June 30, 1879, followed by plan of angle-crib and plan of crib on pile foundation, **79**, 1560.

## CHICAGO RIVER, ILL. (See *Chicago Harbor.*)

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $50,000, | **96**, 2576. |
| 1897, | 113,000, | **97**, 2798. |
| 1898, | 400,000, | **98**, 2423. |
| 1900, | 62,000, | **1900**, 3785. |
| Total, | 625,000 | |

**Commerce.**

Important, **81**, 2165.

Description of, **96**, 2574.

About 11,000,000 tons per annum, 1896, **96**, 2574.

List giving dimensions and tonnage of steamers navigating the river, **97**, 2796.

The river and its branches the most active and important nontidal stream of its length in the United States, **1900**, 3870.

**Contracts.**

**1896.** Green's Dredging Co., dredging, 10.9 cents per c. y.; removing piles, $1 each; removing old dock work, 50 cents per c. y. ($50,193.54), **97**, 2799. Lydon & Drews Co., dredging, 9.7 cents per c. y.; removing old piles, $1 each; removing old dock work, 13 cents per c. y. ($82,438.45), **97**, 2799.

**1899.** The Lydon & Drews Co., dredging, 16.9 cents per c. y. ($39,125.50); constructing 4,782 l. f. dikes (piles, timber, ironwork). Estimated total, entire contract, $86,737.67, **99**, 2828.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 212; **93**, 411; **98**, 401; **99**, 476, 485; **1900**, 541, 550.

ENGINEERS IN CHARGE:

Maj. G. J. Lydecker, 1880. Reports, **81**, 2165, 2167.

Maj. W. L. Marshall, 1897–99. Reports, **97**, 2793; **98**, 2421; **99**, 2826.

Maj. J. H. Willard, 1899–. Reports, **1900**, 3784, 3863, 3865.

## CHICAGO RIVER, ILL.—Continued.

ASSISTANT. G. A. M. Liljencrantz. Reports, **97**, 2800; **98**, 2424; **99**, 2830; **1900**, 3786.

**Legal proceedings.**

Title secured to nearly all the land needed for river widening, **99**, 2828; **1900**, 542.

Secretary of War granted permission to Chicago Sanitary District to connect its artificial-drainage canal with the river subject to the after action of Congress, **99**, 477.

Local requirements connected with dumping into Lake Michigan, **1900**, 3867.

**Obstructions.** (See *Physical characteristics.*)

Sewage and other such waste material deposited in the river, **99**, 2827; **1900**, 3868.

Obstructing bridges and tunnels, **1900**, 3866.

Improvement more or less obstructed by people, city, and other authorities, **1900**, 3868.

**Operations.**

**1895–96.** 24,755 c. y. dredged, **96**, 2574.

**1896–97.** 507,576 c. y. dredged, **97**, 2795.

**1897–98.** 854,352 c. y. dredged, **98**, 2422.

**1898–99.** 25,598 c. y. dredged from South Branch; 392,791 c. y. dredged from North Branch; widening and docking off the river begun (maps), **99**, 2827.

**1899–1900.** 93,591 c. y. dredged from North Branch, **1900**, 3785.

**Physical characteristics.**

Description of, **81**, 2165, 2167; **93**, 2794; **96**, 2573; **97**, 2794.

The river the inner harbor of Chicago, **97**, 2793.

A narrow stream about 16 miles long, lined with wharves and warehouses, and obstructed by numerous bridges. Into it flows the sewage of the city of Chicago. **93**, 2794.

List of bridges crossing it and its branches, **93**, 2807.

The tunnels under the river absolutely limit the draft of vessels, and the bridge draws, docks, and bends absolutely limit the length and beam, **97**, 2795.

Table showing how far vessels of certain dimensions can navigate the river and its branches, **97**, 2797.

Shoaling. Deposits of solid material brought into the stream (see *Obstructions*). **1900**, 3785, 3867.

**Plans.** (See *Projects.*)

Maj. Lydecker, 1880, estimated that the formation of a dredged channel 175 f. wide and 17 f. deep, mouth of the river to junction of the North and South branches, would cost about $27,750, and for that part of the North Branch above the junction to furnish a channel 200 f. wide and 15 f. deep the cost would be about $285,000, but reported that such an improvement should be made by and at the cost of the private and local interests involved, **81**, 2165, 2168.

**Private (city) work.**

In 1895 the Secretary of War permitted the city of Chicago to fill in a part of the outer basin for a public park, **96**, 2572.

South Branch dredged deeper by sanitary district of Chicago, **1900**, 3785.

**Projects.** (See *Plans.*)

By Capt. Marshall, 1893, for dredging the river from its mouth to the stock yards on the South Branch and to Belmont avenue on the North Branch, as far as might be permitted by existing docks and wharves, to permit the passage of vessels drawing 16 f.; and for acquiring title to and cutting away of certain obstructive bends and projecting docks, narrowing and obstructing the channel; estimate, $700,000; estimated annual cost of maintenance from $80,000 to $120,000, **93**, 2800. Adopted by Congress in 1896, continuous contract system, **96**, 2574; **97**, 2794. Estimated annual cost for maintenance, 1898, from $35,000 to $50,000, **98**, 2422.

By Maj. Marshall, 1896, for dredging the river near the Illinois Central and Rush street bridges to a depth of 8 f., **96**, 2573, 2574.

Stability of structures along the river, **1900**, 3866.

Maj. Marshal, estimated, 1899, it would cost $500,000 to $810,600 for 21-f. channel (see *Surveys, 1899*), **1900**, 3870.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 212; made under direction of Maj. Lydecker, 1880, **81**, 2165.

In 1892 Congress directed that a report should be submitted showing what improvement should be made by the Government in the river, an estimate of the cost of such improvement to accompany it. The report was submitted by Capt. Marshall, 1893, (see *Projects*), **93**, 2794.

Examination of the river up to the forks made, 1895–96, by Capt. Marshall, **96**, 2573.

Examination and survey for estimate of cost of 21 f. channel from mouth to stock yards on South Branch and to Belmont avenue on North Branch, as far as permitted by existing docks and wharves, ordered by act of Mar. 3, 1899, made 1899 by Maj. Marshall, (report favorable on some conditions), **1900**, 3863.

MAPS. **97**, 2798; **99**, 2827.

## CHICKAHOMINY RIVER, VA.

**Appropriations.**

1878, $5,000, **78**, 73.
1879, 1,000, **79**, 86.
1880, 2,000, **80**, 779.
1881, 2,000, **81**, 975.
1882, 5,000, **82**, 1043.
1886, 4,000, **86**, 145.
1888, 2,500, **88**, 834.
1890, 2,500, **90**, 1080.
1892, 5,000, **92**, 1092.

Total, 29,000

**Commerce.**

Not unimportant, **75**, ii, 171.

Improvement above Windsor Shades not warranted, **79**, 620.

**Contracts.**

**1878.** H. E. Culpepper, dredging, 14 cents per c. y., **79**, 619.

**1880.** H. E. Culpepper, dredging, 15 cents per c. y., **81**, 974.

**1882.** J. Caler & Son, dredging, 22½ cents per c. y., **83**, 823.

**1886.** H. E. Culpepper, dredging, 14⅝ cents per c. y., **87**, 948.

**1889.** American Dredging Co., dredging, 14 cents per c. y., **89**, 1019.

**1891.** C. T. Caler, dredging, 15¼ cents per c. y., **91**, 1300.

**1893.** C. T. Caler, dredging, 13 and 23 cents per c. y. ($4,700), **93**, 1332.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 95; **78**, 73; **79**, 86; **80**, 115; **81**, 156; **82**, 151; **83**, 157; **84**, 159; **85**, 150; **86**, 145; **87**, 111; **88**, 114; **89**, 132, 135; **90**, 119, 121; **91**, 149, 153; **92**, 151; **93**, 162; **94**, 149; **95**, 171.

ENGINEERS IN CHARGE:

S. T. Abert, U. S. C. E., 1874–91. Reports, **75**, ii, 170; **78**, 521; **79**, 619; **80**, 778; **81**, 973; **82**, 1041; **83**, 823; **84**, 996; **85**, 987; **86**, 920; **87**, 947; **88**, 832; **89**, 1018; **90**, 1079, 1085, 1086.

Capt. G. J. Fiebeger, 1891–92. Reports, **91**, 1299, 1305.

Lt. E. Burr, 1892–94. Reports, **92**, 1091; **93**, 1331; **94**, 980.

Capt. T. L. Casey, 1895. Report, **95**, 1282.

ASSISTANT. J. P. White. Report, **91**, 1306.

**Operations.**

**1878–79.** Channel through Binns Bar dredged to a width of 100 f. and depth of 8 f.; channel through Old Fort and Windsor Shades bars dredged to a width of 60 f. and depth of 8 f., **79**, 619.

**1880–81.** 16,933 c. y. dredged from channel, **81**, 974.

**1882–83.** 19,859 c. y. dredged, **83**, 824.

**1886–87.** 18,299 c. y. dredged from bars, **87**, 948.

**1888–89.** 10,321 c. y. dredged, **89**, 1019.

**1889–90.** 777 c. y. dredged, **90**, 1079.

**1891–92.** 13,000 c. y. dredged, **92**, 1092.

**1893–94.** 17,446 c. y. dredged, **94**, 980.

**1894–95.** 18,188 c. y. dredged, and project completed, **95**, 1283.

**Physical characteristics.**

General, **75**, ii, 170.

Obstructions: Bars, snags, trees, etc., **75**, ii, 170, 171.

Products of the adjacent country, **75**, ii, 172.

Deterioration of depth as compared with other rivers, **75**, ii, 171, 172.

Character of bars, **79**, 619.

Obstructions in channel of river, **82**, 1041.

Description of original condition of river, **86**, 920.

Description of the locality, **90**, 1085.

**Plans.**

By S. T. Abert, 1888, Windsor Shades to Ropes Neck, removal of snags, trees, stumps, and similar obstructions; estimate, $4,000, **90**, 1089.

**Projects.**

By S. T. Abert, U. S. C. E., dredging and removal of logs, snags, trees, etc.; estimate, $10,380, **75**, ii, 172; **78**, 73.

By S. T. Abert, 1878, excavation of channels 100 to 150 f. wide through Binns, Old Fort, and Windsor Shades bars, to a depth of 8 f. at l. w.; estimate, $15,000, **79**, 619; **80**, 115. Increased in 1882 for a channel through the bar at the mouth to $18,000, **82**, 1043. Increased in 1885, $1,000, **85**, 988. In 1887 it was estimated that $10,000 would be required to complete the project, **87**, 947.

By S. T. Abert, 1890, channel from 100 to 150 f. wide and at least 8 f. deep at l. w. through the bar at the mouth; estimate, $7,500, **91**, 149, 1299.

**Surveys.**

Under direction of S. T. Abert, 1874–78, examination in general and a special survey of Binns, Old Fort, and Windsor Shades bars, **75**, ii, 170; **79**, 619.

Ordered by act of Aug. 11, 1888, made 1889, under direction of S. T. Abert, **90**, 1086.

Examination from Holly Landing to Long Bridge ordered by act of Sept. 19, 1890, made 1891, under direction of Lt. Fiebeger (report unfavorable), **91**, 1306.

MAPS. **87**, 948; **89**, 1018.

## CHICKASAWHA RIVER, MISS.

**Appropriations.**

| | |
|---|---|
| 1890, | $5,000, **91**, 1792. |
| 1892, | 5,000, **92**, 1456. |
| 1894, | 5,000, **95**, 1703. |
| 1896, | 2,000, **96**, 1452. |
| 1899, | 2,500, **99**, 1720. |
| Total, | 19,500 |

**Commerce.**

Character of, **79**, 841.

Fine timber lands close to river, **79**, 843.

In 1893 it was estimated that proposed improvement would save producers $50,000 annually, **93**, 1770.

All freight of towns along the river carried by a railroad parallel to the river to the head of navigation, **96**, 1453.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 81; **79**, 105; **89**, 193; **91**, 218; **92**, 211; **93**, 233; **94**, 215; **95**, 240; **96**, 211; **97**, 271; **98**, 265; **99**, 311; **1900**, 353.

ENGINEERS IN CHARGE:

Capt. A. N. Damrell, 1879–95, **78**, 81; **79**, 105. Reports, **79**, 841.

Maj. A. N. Damrell, 1888–95. Reports, **89**, 1463; **91**, 1791; **92**, 1456; **93**, 1769; **94**, 1322; **95**, 1703.

Maj. W. T. Rossell, 1896–. Reports, **96**, 1452; **97**, 1695; **98**, 1442; **99**, 1720; **1900**, 2213.

ASSISTANT. P. Robinson. Report, **79**, 842.

**Operations.**

**1891–92.** 6,000 overhanging trees felled upon the banks, and 6,000 logs cleared, **92**, 1456.

**1892–93.** Over 36,000 obstructions removed from banks and stream, and a small amount of excavation done, **93**, 1769.

**1893–94.** About 4,500 obstructions removed, **94**, 1322.

**1894–97.** Removal of obstructions in progress in 1894–95, **95**, 1703; about 10,000 obstructions removed in 1895–96, **96**, 1452; over 34,000 obstructions removed in 1896–97, **97**, 1696.

**1898–99.** About 8,000 snags and other obstructions removed from banks and channel of the river, **99**, 1720.

**1899–1900.** About 23,000 snags and other obstructions removed from banks and channel of the river, **1900**, 2214.

**Physical characteristics.**

Description of, **79**, 841, 842, 843.

**Plans.** (See *Projects.*)

By P. Robinson, 1879, removing obstructions to l. w. mark, Shubuta to Winchester, 38 miles; to 2 f. below low water, Winchester to Warren's Mill, 12 miles; and 3 f. below low water, Warren's Mill to mouth of the Chickasawha, 80 miles; estimate, $11,500, **79**, 842.

By Maj. Damrell, 1889, channel 2 f. deep and 65 f. wide from Shubuta up to Enterprise, at a cost of $100,000, **89**, 1465.

**Projects.** (See *Plans.*)

By Maj. Damrell, 1889, 3-foot navigable channel, mouth up to the railroad bridge near Shubuta, by removal of logs, snags, and overhanging trees, estimate, $30,000, **89**, 1465; **91**, 1791; **92**, 1456.

In 1893, Maj. Damrell estimated it would cost $2,000 annually for maintenance, **93**, 1770.

**Surveys.**

Examination ordered and in progress, **78**, 81.

Examination completed by P. Robinson, **79**, 105, 841, 842.

Examination ordered by act of Aug. 11, 1888; made 1889, under direction of Maj. Damrell, **89**, 1463.

## CHICOMUXEN CREEK, MD.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 163.

ENGINEER IN CHARGE. S. T. Abert, U. S. Agent. Report, **84**, 1005.

**Survey.**

Examination ordered by act of Aug. 2, 1882; made under direction of S. T. Abert (report unfavorable), **84**, 1005.

## CHINCOTEAGUE BAY TO DELAWARE BAY (Inland waterway between). (See *Delaware Line.*)

**Appropriations.**

| | |
|---|---|
| 1886, | $18,750, **87**, 836. |
| 1888, | 50,000, **88**, 746. |
| 1890, | 50,000, **90**, 932. |
| 1892, | 25,000, **92**, 965. |
| 1894, | 25,000, **95**, 1124. |
| 1896, | 25,000, **96**, 956. |
| Total, | 193,750 |

**Commerce.**

Not unimportant, **85**, 891, 895; **88**, 746; **89**, 893. Small local commerce created by opening of the waterway, **93**, 1204.

**Contracts.**

**1889.** C. McLean, dredging, 21.9 cents per c. y., **89**, 892.

## CHINCOTEAGUE BAY TO DELAWARE BAY—Continued.

**1890.** W. H. Virden, construction of 3 bridges, $1,193, **90**, 932.

**1893.** P. McManus, dredging, 21 cents per c. y., p. m., **94**, 886.

**1895.** J. Jacoby & Co., dredging, 23.5 cents per. c. y., p. m., **95**, 1125.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 137; **87**, 91; **88**, 91; **89**, 106; **90**, 97; **91**, 123; **92**, 123; **93**, 133; **94**, 123; **95**, 139; **96**, 127; **97**, 162; **98**, 166; **99**, 190; **1900**, 217.

ENGINEER IN CHARGE. W. F. Smith, U. S. agent, 1885–. Reports, **85**, 891, 897, 899; **87**, 836; **88**, 745; (Maj.) **89**, 892; **90**, 930; **91**, 1068, 1171; **92**, 956; **93**, 1203; **94**, 884; **95**, 1123; **96**, 955; **97**, 1270; **98**, 1156; **99**, 1381; **1900**, 1642.

ASSISTANTS.

C. M. Bird. Reports, **85**, 891, 898, 900.

A. Stierle. Reports, **91**, 1174; **92**, 962.

**Legal proceedings.**

The Secretary of War was informed in 1892 by the U. S. Attorney-General that in his opinion the validity of the title to the right of way was vested in the U. S., **93**, 1204. In 1895 the Delaware, Maryland & Virginia R. R. obtained an injunction restraining the U. S. from crossing its tracks until the U. S. had obtained right of way, **95**, 1124.

By condemnation proceedings, 1899, an award of $37,343.58 was made to the Delaware, Maryland & Virginia R. R. Co., for the right of way over its bridge, **99**, 1381.

**Operations.**

**1888–89.** 46,619 c. y. dredged, **89**, 892.

**1889–90.** 64,209 c. y. dredged.

**1890–91.** Excavation of cut between Assawoman and Indian River bays completed, and 3 temporary wooden bridges erected, **91**, 1170.

**1891–92.** Draws placed in 3 wooden bridges, **92**, 957.

**1892–93.** About 4 miles of canal constructed, and 3 temporary wooden bridges constructed, **93**, 1204.

**1893–94.** 232,823 c. y., p. m., shoveled and dredged, **94**, 884.

**1894–95.** 109,044 c. y., p. m., shoveled and dredged, **95**, 1124.

**1895–96.** 32,935 c. y., p. m., removed, **96**, 956.

**1897–98.** Negotiations for the condemnation of land belonging to the Delaware, Maryland & Virginia R. R. in progress, **98**, 1157.

**Physical characteristics.**

Description of route, **85**, 892, 902; **91**, 1174.

**Plans.** (See *Projects.*)

By Maj. Smith, 1891, excavation of a canal between Rehoboth and Delaware bays. Estimate, (1) by the Lone Creek route, $460,224; (2) by the Burton Creek route, $692,132; (3) by the Stockley Creek route, $574,581, **91**, 1178, 1179. Stockley Creek route reported the best, **91**, 1180.

**Projects.** (See *Plans.*)

By W. F. Smith, 1885, inland navigation between Chincoteague and Delaware bays, 73 miles, where necessary by a dredged channel 70 f. wide and 6 f. deep at mean low water. Estimate, $350,000. **85**, 897, 879, 904; **91**, 1169; **92**, 956.

Project of 1885 modified, 1892, reducing the width of the canal between Rehoboth Bay and Delaware Bay from 70 to 20 f., **93**, 1204.

By Maj. Smith, 1893, dredging a 4-foot channel 20 f. wide between Synepuxent and Rehoboth bays, and excavation of as much of a cut 20 f. wide and 6 f. deep as could be made with available funds, head of Rehoboth Bay toward Lewes Creek, **93**, 1204.

By Maj. Smith, 1894, expenditure of the appropriation of 1894 in continuing the improvement projected between Indian River and Delaware Bay, and expenditure of any balance from previous appropriations in dredging along the route between Assawoman and Delaware bays, **95**, 1124.

The appropriation of 1896 was made with a proviso that no part of it should be expended until the right of way should be secured without cost to the U. S. except over railroads and county bridges, and then it could be secured by condemnation proceedings, **96**, 956.

**Surveys.**

Examination ordered by act of July 5, 1884, made under the direction of W. F. Smith, **85**, 891, 897, 899; **87**, 836.

Survey for canal between Rehoboth and Delaware bays, made 1891, under direction of Maj. Smith, **91**, 1174.

Examination made in 1894 by Maj. Smith, **94**, 885.

## CHINCOTEAGUE INLET, VA. (See *Franklin City, Va.*)

**Engineers.**
CHIEF OF ENGINEERS. Report, **80**, 110.
ENGINEER IN CHARGE: Maj. W. P. Craighill. Report, **80**, 742.

**Physical characteristics.**
Description of, **80**, 742.

**Plans.**
By Maj. Craighill, 1880, Franklin to Chincoteague Island, channel 200 f. wide, 6 to 8 f. deep at mean low water. Estimate, $61,250 to $143,750, respectively. **80**, 743.

**Survey.**
Ordered by act of Mar. 3, 1879, **79**, 81; **80**, 110; made 1880, under direction of Maj. Craighill, **80**, 742.

## CHINCOTEAGUE INLET, VA. (BREAKWATER.)

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 112; **90**, 102.
ENGINEER IN CHARGE. Maj. W. F. Smith, U. S. agent. Report, **90**, 980.
ASSISTANTS:
D. C. Hudson. Report, **90**, 980.
A. Stierle. Report, **90**, 982.

**Physical characteristics.**
Description of, **90**, 980.

**Plans.**
By Maj. Smith, 1890, construction of 1,200 l. f. of stone breakwater and 15,150 l. f. of jetty, Wallops Beach and Fishing Point; estimate, $3,782,688, **90**, 982.

**Survey.**
Survey for breakwater ordered by act of Aug. 11, 1888; made, 1890, under direction of Maj. Smith, **90**, 981.

## CHIPOLA RIVER (UPPER), FLA., FROM MARIANNA TO ITS MOUTH. (See *Apalachicola River.*)

**Appropriations.**[a]
1835, $5,000, act Feb. 24.
1836, 4,000, act July 2.
1899, 5,000, **99**, 1656.

Total, 14,000

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 291; **1900**, 331.
ENGINEER IN CHARGE: Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1655; **1900**, 2099.

**Obstructions.**
Three bridges near Marianna, **99**, 1655.

**Physical characteristics.**
Description of, **99**, 1655.

**Operations.**
**1899–1900.** Over 10,800 snags and other obstructions removed from banks and channel, and 235 c. y. dredged, **1900**, 2100.

**Projects.**
By Capt. Price, 1889, clearing out a low-water channel 3 f. deep and 60 f. wide, Marianna to the foot of the Dead Lakes; estimate, $41,000. Modified, 1899, to permit the work to begin at Marianna and on that section down the river to Look-and-Tremble Shoals, **99**, 1655.

## CHIPPEWA RIVER, WIS. (See *Mississippi River.*)

| Part. | Appropriations. |
|---|---|
| A.—Chippewa River | $123,214.86 |
| B.—Chippewa River, Yellow Banks | 30,000.00 |
| C.—Part A and Part B | 55,000.00 |
| Total | 208,214.86 |

### Part A.—Chippewa River, Wis. (See *Chippewa River, including Yellow Banks, Wis., Mississippi River, Reservoirs, etc.*)

**Appropriations.**
1876, { $1,800.00, **76**, 707, survey.
{ 10,000.00, **77**, 87, 574.
1878, 10,000.00, **78**, 100, 729.
1879, { 8,000.00, **79**, 135, 1170.
{ 4,664.86, **79**, 1168, survey.
1880, 10,000.00, **80**, 1577.
1881, $10,000.00, **81**, 1749.
1882, 35,000.00, **82**, 1811.
1884, 15,000.00, **84**, 1601.
1886, 18,750.00, **86**, 1488.

Total, 123,214.86

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[a] Appropriations subsequent to 1836, up to 1899, were made with those for Apalachicola River, q. v.

## CHIPPEWA RIVER, WIS.—Continued.

### Part A.—Chippewa River, Wis.—Continued.

**Contracts.**

**1877.** Winston, Douglass & Winston, jetties, **77**, 574.

**1881.** Simar & Morton, dams, brush and stone shore protection, **81**, 1750.

**Documents.** (Not printed in reports.)

Report of Maj. Farquhar of Jan. 30, 1875, H. Doc. 75, 43d Cong., 2d sess., **76**, 707, 709.

**Engineers.**

Chief of Engineers. Reports, **72**, 52; **75**, 63; **76**, 85; **77**, 86; **78**, 100; **79**, 135, 136; **80**, 179; **81**, 241; **82**, 238; **83**, 245; **84**, 246; **85**, 268; **86**, 258; **87**, 225, 229.

Engineers in Charge:

Maj. G. K. Warren, 1868. Reports, **68**, 306, 360, 365, 369, 370.

Col. J. N. Macomb, 1872. **72**, 52.

Maj. F. U. Farquhar, 1874–78. Reports, **75**, 375; **76**, 707; **77**, 574; **78**, 728.

Capt. C. J. Allen, 1878–87. Reports, **79**, 1168, 1171; **80**, 1575; **81**, 748; **82**, 1810; (Maj.), **83**, 1439; **84**, 1600; **85**, 1734; **86**, 1486; **87**, 1699, 1726.

Assistants:

J. E. Turner, **75**, 376.

M. E. Schmidt, **76**, 709.

C. Wanzer. Report, **79**, 1174.

G. Wells. Report, **80**, 1577.

A. O. Powell. Report, **84**, 1602.

V. D. Simar. Report, **85**, 1735.

A. Johnson. Report, **87**, 1729.

**Estimates.** (See *Plans.*)

By Capt. Allen, 1879, completing existing project, $111,892.50, **79**, 1170.

**Legislation.**

Required to prevent injury to navigation by bridge construction, **83**, 1440.

**Operations.**

**1877–78.** Construction of west jetty, 4,013 f., and 405 f. of east jetty, **78**, 728, 729.

**1878–79.** Repairs to west jetty; completion of east jetty, length, 2,110 f., **79**, 135, 1169, 1171.

**1879–80.** 1,360 l. f. brush and stone dams to close channel behind Flower Pot Island, and chute behind Little Missouri Island; 290 f. of base laid for dam at Flower Pot Cut-off; repairs to 950 f. of west jetty, **80**, 1575.

**1880–81.** Repairs to existing works, **81**, 1748.

**1881–82.** 1,108 cords brush and 6,603 c. y. stone placed in brush and stone dams; 40 c. y. excavated, **82**, 1810.

**1882–83.** 7,736 c. y. stone and 2,746 cords of brush put into 650 l. f. of work, **83**, 1439.

**1883–84.** 611 cords brush and 1,142 c. y. stone placed in dams; excavation of bar at Flower Pot Cut-off Dam, **84**, 1602.

**1884–85.** 2,938 c. y. stone and 3,943 of brush placed in dams; repairs to east and west jetties, and to Flower Pot Dam, Battle Island Dam, Dead Lake Cut-off Dam, and Threemile Prairie revetment; 1,000 l. f. of jetty constructed and obstructions removed from Shaws Rapids, **85**, 1734.

**1885–86.** Repairs to west jetty by hired labor, **86**, 1486. List of dams, jetties, and revetments constructed and kept in repair from 1877 to 1886, **86**, 1487.

**1886–87.** Dam construction at Eau Claire, Fivemile Bluff Bar, and Twin Islands, **87**, 1700.

**Physical characteristics.**

Description, **75**, 376; **76**, 707; **79**, 1172, 1176.

Unprecedented high water, **80**, 1576.

Obstructions, **80**, 1578.

Causes of extraordinary overflows on the Chippewa and Wisconsin rivers, **87**, 1726.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Warren, 1868, surveys, $5,000 and $10,000, and for protecting river from sliding banks, $5,000, **68**, 306, 360, 365, 369, 370.

By J. E. Turner, 1874, wing dams and removal of obstructions; estimate, $167,645, **75**, 379.

By Maj. Farquhar, 1875, dam at Upper Dalles, $213,691.55; dam at Lower Dalles, $244,888.56, **76**, 707, 708. Removing obstructions, $139,892.50, **77**, 574; **78**, 729; **79**, 1169.

By C. Wanzer, 1879, revetting the sand banks with slabs and edgings, **79**, 1172, 1179.

**Private and State work.**

Lock and dam built by State authority, **77**, 574.

Training walls and brush dams at mouth of river, **79**, 1172.

List and description of private dams; injurious effects of, **79**, 1173, 1178.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Farquhar, 1875, dredging, wing-dams, and removing obstructions, Eau Claire to mouth. Estimate, $139,892.50, of which amount $64,102.50 was estimated as the cost of protecting the "Yellow Banks" from erosion. **76**, 708; **77**, 574; **78**, 729; **79**, 1169; **80**, 179.

Estimate revised in 1883 by omitting cost of work at Yellow Banks and increasing the cost of the remaining work to $132,476, **83**, 1440; **87**, 1699. From 1876 to 1886, inclusive, $116,750 was ap-

## CHIPPEWA RIVER, WIS.—Continued.

### Part A.—Chippewa River, Wis.—Continued.

propriated. Estimated cost of completion of existing project in 1887, $55,523, **87**, 1701, 1702.

**Surveys.**

By J. E. Turner, under direction of Maj. Farquhar, 1874. Report, **75**, 375.

By M. E. Schmidt, under direction of Maj. Farquhar, 1875. Report, **76**, 707.

Examination, Eau Claire to mouth, **80**, 1575.

Of headwaters in connection with reservoirs on the sources of the Mississippi River, **80**, 1607, 1624; **81**, 1781.

Examination of causes of overflow of the Chippewa and Wisconsin rivers ordered by act of Aug. 5, 1886, made under direction of Maj. Allen, **87**, 1726.

**Maps.**

**81**, 1748; **83**, 1440.

Flower Pot Island to Mississippi River, **87**, 1702.

Seven-Mile Bluff to Dark Slough, **87**, 1702.

At Eau Claire, **87**, 1702.

### Part B.—Chippewa River at Yellow Banks, Wis.

**Appropriation.**

1882, $30,000, **83**, 1443.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **83**, 245; **84**, 246; **85**, 269; **86**, 259; **87**, 226.

ENGINEER IN CHARGE. Maj. C. J. Allen, 1883——. Reports, **83**, 1442; **84**, 1603; **85**, 1737; **86**, 1488; **87**, 1703.

ASSISTANT. A. O. Powell. Report, **84**, 1605.

**Operations.**

**1882–83.** Bank protection in progress at Waubeek, **83**, 1442.

**1883–84.** Bank protection completed at Waubeek, Rumseys, and Mary Dean banks, **84**, 1604; **86**, 1489.

**1884–85.** Repairs to Waubeek Bank protection, **85**, 1738.

**Projects.**

By Maj. Allen, protection of about 26,000 l. f. of river bank at five points below Eau Claire. Estimate, $96,000. **83**, 1442; **86**, 1489.

### Part C.—Chippewa River, including Yellow Banks, Wis. (See *Chippewa River*.)

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $10,000, | **88**, 1546. |
| 1890, | 10,000, | **90**, 2086. |
| 1892, | 5,000, | **92**, 1836. |
| 1894, | 10,000, | **95**, 2190. |
| 1896, | 10,000, | **96**, 1851. |
| 1899, | 10,000, | **99**, 2195. |
| Total, | 55,000 | |

**Commerce.**

Lumber interests, **89**, 1796; annual tonnage of rafted lumber about 300,000 tons, and of loose logs about 1,000,000 tons, **1900**, 437.

Description of, **95**, 2187.

Channel surveyed in 1896 sufficient for the limited needs of the commerce involved, **96**, 1864.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **88**, 203; **89**, 236; **90**, 212; **91**, 270; **92**, 258; **93**, 290; **94**, 266; **95**, 296; **96**, 256, 259; **97**, 328; **98**, 319; **99**, 380; **1900**, 437.

ENGINEERS IN CHARGE:

Maj. C. J. Allen, 1878–90. Reports, **88**, 1542; **89**, 1794.

Maj. W. A. Jones, 1890–97. Reports, **90**, 2084; **91**, 2201; **92**, 1833; **93**, 2272; **93**, 1718; **95**, 2183; (Lt. Col.) **96**, 1849, 1864; **97**, 2152.

Capt. F. V. Abbot, 1898–. Reports, **98**, 1821; (Maj.) **99**, 2195; **1900**, 2806.

ASSISTANT: R. Davenport. Reports, **98**, 1823; **99**, 2196; **1900**, 2808.

**Operations.**[a]

**1887–88.** Training dam at Eau Claire leveled off and repaired; dam at Dark Slough repaired and extended 95 f.; brush and stone dams at Five-Mile Bluff, Battle Island, and Dead Lake Cut-off, and jetties at mouth of river repaired; shore revetment at head of east jetty extended 150 f.; repairs to revetment at Yellow Banks, **88**, 1542–1545.

**1888–89.** 1,305 l. f. of wing dam built at Plum Island Flats; 576 l. f. of dam and revetment built at Battle Island, Dark Slough, and Wacouta Island dams. Repairs to existing works; 3,026 c. y. stone and 1,314 c. y. brush used, **89**, 1795.

**1889–90.** Repairs to east and west jetties at mouth of river; 90 cords stone and 164 cords brush used, **90**, 2085.

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[a] List of dams, jetties and revetments, and Yellow Banks protections, constructed and kept in repair from 1877, **94**, 1720; **95**, 2189.

## CHIPPEWA RIVER, WIS.—Continued.

### Part C.—Chippewa River, including Yellow Banks, Wis.—Cont'd.

**1891-92.** Pile boom built at Dead Lake Cut-off; Plum Island Flats Dam No. 2 built, and foundation courses of Dam. No. 3 laid, **92**, 1834.

**1892-93.** Brush and stone dam built at Eau Galle Flats; Plum Island Flats Dam No. 3 repaired, **93**, 2273.

**1893-94.** Eau Galle Flats Dam, injured by ice, repaired, **94**, 1719.

**1894-95.** Closing dam built at Plum Creek, and Plum Island Flats Dam repaired, **95**, 2188.

Table as in preceding year.

**1895-96.** Repairs made to Plum Island Dam No. 3 and to east jetty at river mouth; Wacouta Island Dams Nos. 2 and 3 built to assist Wacouta Island Dam No. 1 in maintaining low-water flow on right side of island, **96**, 1850.

**1896-97.** Wacouta Island Dam No. 1 repaired, **97**, 2152.

**1897-98.** Dams repaired, **98**, 1821.

**1898-99.** Eau Galle Dam repaired, and Dead Lake Bar Dam being constructed, 4,800 c. y. dredged at Dead Lake Bar, **99**, 2197.

**1899-1900.** 10,675 c. y. dredged; new dams built at Plum, Crow, and Wacouta islands; repairs made to the Old Plum Island dams, **1900**, 2806, 2808.

**Physical characteristics.**

Description of, **95**, 2183.

Severe ice jams, **93**, 2273.

**Projects.** (See *Part A* and *Part B.*)

In 1888 $45,552 was estimated as required for completion of the Chippewa River improvement, and $66,000 for completion of improvement at Yellow Banks, making a total for completion of both projects of $111,552, **88**, 1544-1546. Increased in 1889 to $115,737.72, **89**, 1797; **91**, 2201.

**Survey.**

Survey of the river for 2 miles south of Dells Dam ordered by act of Aug. 17, 1894, report (unfavorable) rendered by Lt. Col. Jones, 1896, **96**, 1864.

## CHITTA BAYOU (BOGUE CHITTO), LA.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $5,000, | **91**, 1800. |
| 1892, | 5,000, | **92**, 1466. |
| 1894, | 5,000, | **95**, 1711. |
| 1896, | 5,000, | **96**, 1460. |
| 1899, | 5,000, | **99**, 1729. |
| Total, | 25,000 | |

**Commerce.**

The work proposed in 1893 would probably make an annual saving of $30,000 in freight rates, **93**, 1782.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 193; **91**, 220; **92**, 214; **93**, 237; **94**, 218; **95**, 243; **96**, 213; **97**, 274; **98**, 268; **99**, 316; **1900**, 358.

ENGINEERS IN CHARGE:

Maj. A. M. Damrell, 1888-95. Reports, **89**, 1465; **91**, 1800; **92**, 1466; **93**, 1781; **94**, 1331; **95**, 1711.

Maj. W. T. Rossell, 1896-. Reports, **96**, 1460; **97**, 1703; **98**, 1445; **99**, 1729; **1900**, 2222.

**Operations.**

**1891-92.** Preparing plant, **92**, 1466.

**1892-93.** Snag boat finished, **93**, 1782.

**1893-94.** About 9,000 obstructions removed from banks and stream, 150 c. y. sand removed, and jetty and shore protection work in progress, **94**, 1331.

**1894-95.** About 11,000 obstructions removed, 156 c. y. sand excavated and removed, and jetty and shore protection work continued, **95**, 1711.

**1895-96.** About 6,000 obstructions removed, and 300 l. f. bank protection completed, **96**, 1460.

**1896-97.** About 800 obstructions removed, and 58 c. y. sand, etc., excavated and removed, **97**, 1703.

**1897-98.** About 7,000 obstructions removed, **98**, 1446.

**1898-99.** About 17,000 snags and other obstructions removed from banks and channel of the river, and 2,389 c. y. gravel and sand excavated aud deposited in dams, **99**, 1729.

**1899-1900.** About 13,000 snags and other obstructions removed from banks and channel of the river, **1900**, 2222.

**Projects.**

By Maj. Damrell, 1889, channel 3 feet deep, by removing snags, logs, overhanging trees, and fish traps, and closing the west mouth from its junction up to Alfords Bridge; estimate, $30,000, **89**, 1466; **91**, 220; **92**, 1466.

**Survey.**

Examination ordered by act of Aug. 11, 1888; made, 1889, under direction of Maj. Damrell, **89**, 1465.

**CHITTO BOGUE.** (See *Chitta Bayou, La.*)

## CHOCOLATE BAYOU, TEX.

**Commerce.**

About 10,000 tons of produce and merchandise carried annually to and from Galveston, **1900**, 2405.

**Engineers.**

Chief of Engineers. Report, **1900**, 395.

Engineer in Charge. Capt. C. S. Riché, 1899–. Reports, **1900**, 2403, 2406.

Assistant. S. M. Wilcox. Report, **1900**, 2407.

**Physical Characteristics.**

Chocolate Bayou empties into Chocolate Bay, which latter merges with Galveston Bay about 12 miles north of San Luis Pass and is one of the adjacent streams referred to in the appropriation of March 3, 1899, for improving "Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams," **1900**, 2404.

Description of Bayou, **1900**, 2407.

**Projects.**

Capt. Riché estimated, 1900, it would cost $15,000 to make the improvement as a component part of a light-draft inland navigation system, **1900**, 2406.

**Survey.**

Examination and survey ordered by act of Mar. 3, 1899; made, 1899–1900, under direction of Capt. Riché (report favorable) (see *Projects*), **1900**, 2404, 2406.

## CHOCTAWHATCHEE BAY AND SANTA ROSA SOUND, FLA. (Bar at junction of).

**Commerce.**

Description of; value estimated at $800,000 per annum, **93**, 1741.

**Engineers.**

Chief of Engineers. Report, **93**, 228.

Engineer in Charge. Capt. P. M. Price, 1889–93. Report, **93**, 1741.

Assistant. J. E. Turtle. Report, **93**, 1742.

**Physical characteristics.**

Description of; Santa Rosa Sound is a narrow body of water, about 14 miles long, between Santa Rosa Island and the mainland, connecting Pensacola Bay with Choctawhatchee Bay, **93**, 1741.

**Survey.**

Examination of the bar at the junction of Choctawhatchee Bay and Santa Rosa Sound, Fla., ordered by act of July 13, 1892, made under the direction of Capt. Price, 1893, (report favorable), **93**, 1741.

## CHOCTAWHATCHEE RIVER, FLA.[a] (See *Holmes River, Fla., Lagrange Bayou, St. Andrews Bay, Savannah, Ockmulgee, Flint, and Choctawhatchee rivers.*)

**Appropriations.**

| | | |
|---|---|---|
| 1833, | $5,000, | act March 2. |
| 1844, | [b]10,000, | act June 5. |
| 1874, | 5,000, | **74**, 75, 896. (Survey.) |
| 1875, | 5,000, | **75**, 81, ii, 9. |
| 1876, | 5,000, | **76**, 72, 494; **77**, 71, 414. |
| 1879, | 5,000, | **79**, 103, 827. |
| 1880, | 7,000, | **80**, 1079. |
| 1881, | 10,000, | **81**, 1197. |
| 1882, | [c]18,000, | **82**, 1275. |
| 1884, | 15,000, | **84**, 1184. |
| 1886, | 15,000, | **86**, 1177. |
| 1888, | 10,000, | **88**, 1168. |
| 1890, | 12,500, | **90**, 1633. |
| 1892, | 12,500, | **92**, 1411. |
| 1894, | 6,000, | **95**, 1628. |
| 1896, | 5,000, | **96**, 1371. |
| 1899, | 16,000, | **99**, 1665. |
| Total, | 162,000 | |

**Commerce.**

Requirements, **72**, 64, 588, 640.

Amount of, to be benefited by improvement, **80**, 1080.

Increase of, consequent upon improvement, **81**, 1195.

Increase in cotton shipments, **89**, 1382.

Important, **95**, 1628.

**Contracts.**

M. A. Sweeney, snag-boat construction, $4,800, **89**, 1383.

**Engineers.**

Chief of Engineers. Reports, **71**, 69; **72**, 63; **74**, 75; **75**, 80; **76**, 72; **77**, 70; **78**, 79; **79**, 103; **80**, 136, 140; **81**, 184; **82**, 180; **83**, 190; **84**, 198; **85**, 205; **86**, 203; **87**, 165; **88**, 153; **89**, 178, 185; **90**, 160; **91**, 201; **92**, 197; **93**, 218; **94**, 202; **95**, 228; **96**, 202; **97**, 257; **98**, 254; **99**, 294; **1900**, 335.

Engineers in Charge:

Col. J. H. Simpson, 1871. Reports, **72**, 588, 640.

Lt. Col. W. F. Raynolds, 1872. **73**, 66.

Capt. A. N. Damrell, 1873–85. **73**, 66. Reports, **74**, 896; **75**, ii, 8; **76**, 493; **77**, 413; **78**, 590; **79**, 824; **80**, 1079, 1081; **81**, 1194; **82**, 1270; (Maj.) **83**, 988; **84**, 1180.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1311; **86**, 1176; **87**, 1271; **88**, 1166.

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[a] Examination—Report (favorable) Jan. 28, 1845. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Choctawhatchee and Holmes rivers.

[c] Part of $20,000, $2,000 of which was for Lagrange Bayou.

## CHOCTAWHATCHEE RIVER, FLA.—Continued.

Capt. P. M. Price, 1889–93. Reports, **89**, 1380, 1423; **90**, 1631; **91**, 1707; **92**, 1409; **93**, 1706.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1263; **95**, 1626; **96**, 1365; **97**, 1621; **98**, 1394.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1664; **1900**, 2112.

ASSISTANTS:

J. Burney. Report, **72**, 641.

W. S. Simpson, **72**, 588.

H. Haines. Report, **80**, 1081.

W. A. Gould. Report, **90**, 1633.

W. G. Williamson. Report, **89**, 1425.

J. E. Turtle. Reports, **91**, 1708; **92**, 1410.

**Legislation.**

Law passed by Alabama to prohibit the driving of loose logs in the Choctawhatchee River within the State, **89**, 1382.

**Obstructions.**

Draw to be placed in Hollis Bridge before improvement of river above it, **96**, 1366.

**Operations.**

**1874–75.** Obstructions removed from river for a distance of 48 miles from mouth, **75**, 81, ii, 8.

**1875–76.** Removal of obstructions; 3-f. channel obtained from mouth to Buzzard's Bar; wagon road cut around the bar, **76**, 72, 493.

**1876–77.** Channel 3 f. in depth obtained for about 75 miles of the lower part of the river by removal of obstructions, **77**, 70, 413.

**1877–78.** Obstructions removed; removal of gravel and drift at Miller's Field, **78**, 79, 590.

**1879–80.** 20 miles of river between Geneva and mouth cleaned of snags and obstructions; cut-off opened; Buzzard Bar Cut-off cleaned out; portion of wreck of steamer *Boston* removed, **80**, 1079.

**1880–81.** 14,256 snags, stumps, and trees removed; 252 c. y. sand excavated, **81**, 1195.

**1881–82.** 10,169 snags, stumps, etc., removed; 330 y. of bank protected by brush, **82**, 1272.

**1882–83.** 34 miles wholly and 161 miles partially improved by removal of 15,074 snags and trees, protection of 4,940 l. y. of bank, and closure of 6 cut-offs, **83**, 990.

**1883–84.** 29,819 snags, stumps, and trees removed; 990 l. f. bank protected, **84**, 1181.

**1884–85.** Operations of snag boat, **85**, 1311.

**1885–86.** 8,787 snags, logs, and trees removed, clearing 32 miles of river, **86**, 1176. Improvement completed from mouth of river to a distance of 27 miles above Geneva, **86**, 1176.

**1886–87.** Operations of snag boat; removal of rocks and bowlders, **87**, 1272.

**1887–88.** 5,772 logs and snags removed from the channel, **88**, 1168.

**1888–89.** 3,183 trees, logs, and snags removed from the channel, and 695 trees from the banks, **89**, 1382.

**1889–90.** Removal of snags, stumps, and channel obstructions continued, **90**, 1633.

**1890–91.** Removal of snags and similar obstructions continued, **91**, 1708.

**1891–92.** 2,142 snags removed from the channel, and 386 trees cleared from the banks, **92**, 1410.

**1892–93.** 1,248 obstructions removed from banks and stream, and 1,654 l. f. dams completed, **93**, 1709.

**1893–94.** 1,781 obstructions removed, and 3,261 l. f. dams constructed, **94**, 1267.

**1894–95.** 1,281 obstructions removed, **95**, 1627.

**1895–96.** 2,381 obstructions removed, **96**, 1371.

**1896–97.** A few obstructions removed, **97**, 1623.

**1899–1900.** Over 4,400 obstructions removed, **1900**, 2113.

**Physical characteristics.**

Description, **72**, 63, 588, 640–645; **79**, 826; **96**, 1365; **97**, 1621; **98**, 1394.

Description of river obstructions, **80**, 1081.

Comparison of cross sections at Buzzard Bar shoals, Gumfields shoals, Busby shoals, **93**, 1708; Haverstons Whirl, and Cut-Off, **94**, 1266.

**Plans.** (See *Projects.*)

By J. Burney, 1872, thorough improvement of river; estimate, $98,716.80. To meet present and prospective requirements of commerce, $52,291.20. Removal of obstructions which seriously interfere with trade, $34,332; the last recommended by Col. Simpson, **72**, 64, 589, 640, 646.

By Capt. Price, 1889, channel 60 f. wide and 3 f. deep between Geneva and Newton, by dredging shoals and removing snags and logs; estimate, $57,125, **89**, 1424.

**Projects.** (See *Plans.*)

By Col. Simpson, 1872, mouth to Geneva, 212 miles, by removal of snags, sunken logs, etc.; estimate, $44,332, **72**, 63, 589, 641; **74**, 896; **81**, 1194.

By Capt. Damrell, 1880, Geneva to Newton, 40 miles, removal of obstructions and construction of 3 locks and dams; estimate, $78,500, **80**, 1081; making an aggregate of $122,832 for the improvement of the river, mouth to Newton, **86**, 1177; **87**, 1272.

## CHOCTAWHATCHEE RIVER, FLA.—Continued.

Amended, 1896, to require a draw to be placed in Hollis Bridge before any money could be spent above this bridge, **96**, 1366.

Amended, 1899, to extend the improvement to Newton, Ala., **99**, 1664.

**Surveys.**

By J. Burney and W. Simpson, 1871–72, under directon of Col. Simpson. Reports, **72**, 588, 641.

Examination, Geneva to Newton, ordered by act of March 3, 1879, made under the direction of Capt. Damrell, 1880. Recommendation to defer improvement. **80**, 1081.

Examination for a low-water channel, Geneva to Newton, ordered by act of August 11, 1888, made, 1889, under direction of Capt. Price, **89**, 1423.

MAPS. **93**, 1708; **94**, 1266.

## CHOPAWAMSIC BAY, VA.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 76; **76**, 71.

ENGINEER IN CHARGE. Maj. W. P. Craighill, 1871. Reports, **71**, 620; **72**, 707.

ASSISTANTS:
Capt. C. B. Phillips. Report, **72**, 713.
J. E. Weyss, **72**, 707, 713.
G. Thompson, **72**, 707, 713.

**Physical characteristics.**

An estuary of the Potamac River, 40 miles below Washington City; the bottom soft mud; the banks well timbered; at the head of the bay is Chopawamsic Creek, **72**, 713.

**Plans.**

By Capt. Phillips, concurred in by Maj. Craighill, opening a cut across from the creek to the Potomac, forming a new mouth ½ mile from the present one. Estimated cost, by Capt. Philiips, of a cut 80 f. wide at bottom by 10 f. deep, $6,945.40; or 12 f. in depth, $9,522.92. Increased, by Maj. Craighill, to $7,000 and $10,000, respectively, **72**, 707, 708, 714, 715.

**Surveys.**

Under the direction of Maj. Craighill and the immediate supervision of Capt. Phillips, by J. E. Weyss and G. Thompson. Reports, **71**, 620; **72**, 707, 713.

## CHOPTANK RIVER, MD.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $5,000, | **80**, | 636. |
| 1881, | 5,000, | **81**, | 874. |
| 1882, | 5,000, | **82**, | 852. |
| 1884, | 5,000, | **84**, | 902. |
| 1886, | 10,000, | **86**, | 869. |
| 1888, | 7,500, | **88**, | 749. |
| 1890, | 7,500, | **90**, | 939. |
| 1892, | 3,000, | **92**, | 972. |
| 1894, | 2,000, | **95**, | 1131. |
| 1896, | 2,000, | **96**, | 961. |
| 1899, | 8,000, | **99**, | 1385. |
| Total, | 60,000 | | |

**Commerce.**

Value of the improvement to, **88**, 748.

**Contracts.**

**1880.** D. Constantine, dredging, 23 cents per c. y., **81**, 875.

**1881.** D. Constantine, dredging, 27½ cents per c. y., **81**, 876.

**1882.** D. Constantine, dredging, 27½ cents per c. y., **83**, 677.

**1884.** Morris & Cumings, dredging, 21 cents per c. y., **85**, 887.

**1886.** T. P. Morgan, dredging, 16 cents per c. y., **87**, 840.

**1889.** American Dredging Co., dredging, 15 cents per c. y., **90**, 938.

**1891.** C. T. Caler, dredging, 14½ cents per c. y., **91**, 1191.

**1892.** C. T. Caler, dredging, 10 cents per c. y., s. m., **93**, 1214.

**1895.** Baltimore Dredging Co., dredging, 19.8 cents per c. y., p. m., **95**, 1131.

**1896.** C. T. Caler, dredging, 9.5 cents per c. y., p. m., **97**, 1275.

**1899.** Baltimore Dredging Co., dredging, 12.4 cents per c. y., p. m., **1900**, 1647.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 102; **81**, 135; **82**, 131; **83**, 136; **84**, 144; **85**, 134; **86**, 131, **87**, 94; **88**, 93; **89**, 110; **90**, 100; **91**, 127; **92**, 127; **93**, 137; **94**, 126, **95**, 143; **96**, 130; **97**, 164; **98**, 168; **99**, 193; **1900**, 220.

ENGINEERS IN CHARGE:

Lt. Col. W. P. Craighill, 1879–85. Reports, **80**, 634; **81**, 874; **82**, 851; **83**, 676; **84**, 901.

W. F. Smith, U. S. Agent, 1885——. Reports, **85**, 886; **86**, 868; **87**, 840; **88**, 748; (Maj.) **89**, 900; **90**, 938; **91**, 1189; **92**, 972; **93**, 1213; **94**, 891; **95**, 1130; **96**, 960; **97**, 1275; **98**, 1160; **99**, 1384; **1900**, 1646.

ASSISTANT: G. W. Parsons. Report, **81**, 876.

## CHOPTANK RIVER, MD.—Continued.

**Operations.**

**1881–82.** 32,071 c. y. dredged, **82**, 852.

**1882–83.** 450 f. of channel, 22 f. wide and 6 f. deep, dredged, **83**, 677; 1,250 f. of channel, 22 f. wide, with a depth of 5 f. at m. l. w., dredged through shoal below Cose's, **84**, 901.

**1884–85.** Additional width of 25 f. given to the 22-f. cut throughout its length, **85**, 135.

**1886–87.** 1,671 c. y. dredged from channel, **87**, 841.

**1887–88.** 45,220 c. y. dredged from the channel, **88**, 748.

**1889–90.** Dredging resumed, **90**, 938.

**1890–91.** 43,827 c. y. dredged, **91**, 1189.

**1892–93.** 70,538 c. y., s. m., dredged, **93**, 1213.

**1895–96.** 7,526 c. y., p. m., dredged, **96**, 960.

**1898–99.** 15,988 c. y., p. m., dredged, **99**, 1384.

**1899–1900.** 55,003 c. y., p. m., dredged, **1900**, 1647.

**Physical characteristics.**

River dimensions, and bridge crossings, **80**, 634, 635.

**Projects.**

By Lt. Col. Craighill, 1880, dredged channel, 75 f. wide and 8 f. deep at m. l. w., Denton to Gainesboro. Estimate, $79,000, **80**, 636; **87**, 94; **91**, 1190; **92**, 972.

**Survey.**

Ordered by act of Mar. 3, 1879, **80**, 102, made, Denton to Greensboro, 1880, under the direction of Maj. Craighill, **80**, 634.

## CHOWAN RIVER, N. C.

**Commerce.**

Would not justify cost of improving river, **79**, 727, 728.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 76; **79**, 95.

ENGINEERS IN CHARGE. Capt. C. B. Phillips, **78**, 76; **79**, 88. Report, **79**, 726.

ASSISTANT. W. G. Williamson. Report, **79**, 728.

**Physical characteristics.**

Description of, **79**, 727, 728.
Obstructions, **79**, 728.

**Plans.**

Capt. Phillips, 1879, recommends that both eastern and western channels be marked with buoys, **79**, 728.

By W. G. Williamson, 1879, removing obstructions, **79**, 728, 729. Not approved, **79**, 728, 729.

**Surveys.**

**1878.** Ordered and in progress, **78**, 76. Completed by W. G. Williamson (see *Commerce*), **79**, 95, 727.

## CHRISTIANA RIVER, DEL. (See *Wilmington Harbor, Del.*)

## CHUCKATUCK CREEK, VA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 120.

ENGINEER IN CHARGE. Lt. G. J. Fieberger, 1889. Report, **89**, 968.

ASSISTANTS:
J. Riddle. Report, **89**, 969.
T. I. George. Report, **89**, 970.

**Physical characteristics.**

Description of, **89**, 969.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Fiebeger (report unfavorable), **89**, 968.

## CHURCHES COVE HARBOR, LITTLE COMPTON, R. I. (Breakwater).[a]

**Appropriations.**

| | |
|---|---|
| 1827, | $200, Mar. 2 (survey). |
| 1836, | 10,000, July 4. |
| 1838, | 18,000, July 7. |
| Total, | 28,200 |

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[a] Survey—Report Feb. 9, 1828, estimate, $24,062.85. (H. Doc. No. 482, 55th Cong., 2d sess.)

### CINCINNATI. (See *Ohio River.*)

### CITY WEST HARBOR, IND.[a]

### CLACKAMAS RAPIDS. (See *Willamette River, Oreg.*)

### CLACKAMAS RIVER, OREG.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 357.

ENGINEER IN CHARGE. Capt. W. Young. Report, **89**, 2523.

**Physical characteristics.**

Description of, **89**, 2524.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Capt. Young (report unfavorable), **89**, 2523.

### CLAIBORNE HARBOR, MD.

**Commerce.**

Improvement intended to develop a large trade in receiving, canning, and shipping oysters, **95**, 1200.

Description of, **1900**, 1681.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 157; **99**, 203; **1900**, 230.

ENGINEERS IN CHARGE:

Col. W. P. Craighill, 1890–95. Report, **95**, 1200.

Maj. Wm. F. Smith, U. S. Agent, 1900–. Reports, **1900**, 1677, 1680.

ASSISTANT. C. M. Baird. Report, **1900**, 1678.

**Physical characteristics.**

Description of, **95**, 1200; **1900**, 1678.

**Private work.**

Dredging by Baltimore and Eastern Shore R. R. Co., at a cost of about $20,000, **95**, 1200.

**Projects.**

Maj. Smith, estimated, 1899, it would cost $17,490 for a 12-f. channel, **1900**, 1681.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made by Col. Craighill, 1894 (report unfavorable), **95**, 1200.

Examination and survey ordered by act of Mar. 3, 1899; examination made, 1899, under direction of Maj. Smith (report favorable); survey made, 1899, by Maj. Smith (see *Projects*), **1900**, 1677, 1678, 1680.

### CLALLAM BAY, WASH.

**Commerce.**

Description of: Straits of Fuca is the passage through which all the commerce of Puget Sound and the Gulf of Georgia connects with the Pacific Ocean, **95**, 3457.

**Engineers.**

CHIEF OF ENGINEERS. Report, **95**, 457.

ENGINEER IN CHARGE. Capt. T. W. Symons, 1895. Report, **95**, 3456.

**Physical characteristics.**

Description of: A shallow indentation on the southern shore of the Straits of Juan de Fuca, 24 miles to the east of Cape Flattery, well sheltered from the south, east, and west, but open to the north, **95** 3457.

Rainfall very great; fog prevails for three months in the year, **95**, 3459.

Currents run through the strait with great velocity. Anchorage ground fair. List of wrecks that occurred in the twenty years previous to 1895 in the vicinity. **95**, 3460.

**Survey.**

Examination with a view to a harbor of refuge ordered by act of Aug. 17, 1894, made 1895, under the direction of Capt. Symons (report unfavorable), **95**, 3456.

### CLARENDON AND LOWER WHITE RIVERS, ARK.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 257; **92**, 247, 1697.

ENGINEERS IN CHARGE:

Capt. H. S. Taber. Reports, **92**, 1698, 1700.

Col. C. B. Comstock. Report, **92**, 1704.

**Physical characteristics.**

Description of, **92**, 1698.

**Plans.**

By Col. Comstock, 1892, levee construction, 5,100,000 c. y., Helena to the White River, estimate, $1,100,000, **92**, 1704.

**Survey.**

Survey to prevent injury from backwater from the Mississippi River ordered by act of Sept. 19, 1890, made, 1892, under direction of Capt. Taber, **92**, 1700.

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[a] Survey—Report, Feb. 8, 1838; estimate, $150,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CLARION RIVER, PA.

**Commerce.**

Lumber statistics, **82**, 1938, 1944.

Description of: This stream first in commercial importance of the Allegheny tributaries; annual tonnage estimated at 125,000 tons, **96**, 2209.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 263; **82**, 257; **95**, 328; **96**, 283.

ENGINEERS IN CHARGE:

Maj. W. E. Merrill. Report, **82**, 1938.

Maj. R. L. Hoxie, 1896. Report, **96**, 2208.

ASSISTANTS:

J. Worrall. Report, **82**, 1939.

J. W. Arras. Report, **96**, 2210.

**Physical Characteristics.**

Description of, **82**, 1938, 1939, 1942.

Description of. Second in the order of area drained by Allegheny River tributaries. Navigability of the river dependent on high water, **96**, 2209.

**Plan.**

Maj. Merrill reported, 1881, that until the Allegheny River had been radically improved there was but small need of improvement of its tributaries except to keep open navigation by the removal of rocks and similar obstructions, which could be done on Clarion River at an estimated cost of $40,000, **82**, 1938, 1941.

**Surveys.**

Ordered by act of Mar. 3, 1881, made under direction of Maj. Merrill, 1881, **82**, 1938.

Examination ordered by act of Aug. 17, 1894, made, 1895, under direction of Maj. Hoxie (report favorable only to obstruction removal), **96**, 2208.

## CLARKS (RIVER) CREEK, S. C.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $2,500, | **88**, | 129. |
| 1890, | 2,500, | **90**, | 1204. |
| 1892, | 2,500, | **92**, | 1207. |
| Total, | 7,500 | | |

**Commerce.**

Prospective commerce of the creek, **89**, 1166.

Description of, **93**, 1479; **94**, 1080.

The aggregate tonnage moved on the river in 1892–93 was 7,628 tons, **93**, 1477; in 1893–94 and 1894–95, 7,000 tons, **94**, 1080; **95**, 1405.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 139; **88**, 128; **89**, 151; **90**, 136; **91**, 172; **92**, 171; **93**, 185; **94**, 170; **95**, 194.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1887. Reports, **87**, 1109, 1110.

Capt. F. V. Abbot, 1888–95. Reports, **89**, 1164; **90**, 1203; **91**, 1453; **92**, 1206; **93**, 1477; **94**, 1079; **95**, 1404.

ASSISTANT. R. Whitford. Reports, **89**, 1165; **90**, 1204; **91**, 1454; **92**, 1207; **93**, 1478; **94**, 1080.

**Operations.**

**1889–90.** 1,063 trees and snags and 12 cords of small snags removed from the channel, and 195 trees and 35 cords of brush removed from the banks, **90**, 1204.

**1891–92.** 4,396 snags and logs and 394 cords of small snags removed from the channel, and 553 trees cut from the banks, **92**, 1207.

**1892–93.** About 7,000 snags and other obstructions removed from the banks and river, **93**, 1478.

**Physical characteristics.**

Description, **87**, 1109.

**Projects.**

By Capt. Bixby, 1887, removal of snags and leaning trees, and closing the northern mouth of Lynches River; estimate, $7,500, **87**, 1,111; **89**, 1164; **91**, 1453.

**Survey.**

Ordered by act of August 5, 1886, made, 1887, under direction of Capt. Bixby, **87**, 1610.

MAPS. **90**, 1204.

**CLARK RIVER.** (See *Lewis and Clark River, Oreg.; Lynchs River, S. C.*)

**CLARKS FORK.** (See *Columbia River.*)

**CLARKS RIVER.** (See *Youngs, Lewis, etc.*)

## CLARKSVILLE HARBOR, MO.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 231.

ENGINEER IN CHARGE. Capt. E. H. Ruffner. Report, **89**, 1722.

**Plans.**

By Capt. Ruffner, 1889, closing the chute between Clarksville Island and the Illinois shore by a gravel dam 1,000 f. long, and construction of a wing dam above the head of the island from the Illinois shore, in such a direction and of such a length as will serve to confine the channel to the Missouri shore; estimate, $25,000, **89**, 1724.

**Survey.**

Examination ordered by act of Aug. 11, 1888; made, 1889, under direction of Capt. Ruffner, **89**, 1722.

## CLATSKANIE RIVER, OREG.

**Appropriation.**

1899, $13,000, **99**, 3247.

**Commerce.**

Description of, **95**, 3598; **98**, 3050.

In 1893 large quantities of lumber were shipped; value estimated at $500,000, **95**, 3598.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 467; **98**, 510; **99**, 595; **1900**, 672.

ENGINEERS IN CHARGE:

Maj. J. C. Post, 1895. Report, **95**, 3596.

Maj. W. L. Fisk, 1898–99. Reports, **98**, 3049; **99**, 3247.

Capt. W. C. Langfitt, 1899.

Capt. W. W. Harts, 1899–. Report, **1900**, 4363.

**Legal proceedings.**

Negotiations to acquire title to necessary land, **1900**, 4363.

**Physical characteristics.**

Description of, **95**, 3597.

The river rises in the Nehalem Mountains and enters Columbia River 70 miles below the city of Portland. The principal obstructions up to Clatskanie City, 1895, were the abrupt bends in the channel and the varying depth of from 2 to 6 f. at low water. The distance from its mouth to Clatskanie is 3 miles, and the width of the stream to there about 75 f. **95**, 3597.

**Projects.**

By Capt. Fisk, 1897, cutting a short channel across a bend immediately below Manzanillo and another through the bend above this point to the first bend below the town of Clatskanie, and for dredging immediately below the latter point; estimate, $13,000, **98**, 3049; **99**, 3247.

It was estimated, 1900, that the river could be kept in good navigable condition with $1,500 annually, **1900**, 4363.

**Surveys.**

Examination, mouth to Clatskanie, ordered by act of Aug. 17, 1894, made, 1895, by Maj. Post (report favorable), **95**, 3596.

Survey of the same locality ordered by act of June 3, 1896, made, 1897, by Capt. Fisk (report favorable; see *Projects*), **98**, 3049.

## CLEAR CREEK, TEX.

**Commerce.**

Commerce consists of farm products shipped to Galveston, with return shipments of groceries and general merchandise, **1900**, 2387.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900**, 395.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–1900. Reports, **1900**, 2385, 2388.

ASSISTANT. S. M. Wilcox. Report, **1900**, 2389.

**Obstructions.**

The creek crossed by the Columbia Tap; Gulf, Colorado and Santa Fe; Galveston, Houston and Henderson; and the Galveston, La Porte and Houston R. R.; the latter, near the mouth, is the only road having a drawspan in its bridge, **1900**, 2390.

**Physical characteristics.**

Clear Creek empties into Galveston Upper Bay, and is one of the adjacent streams referred to in the appropriation of Mar. 3, 1899, for improving "Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bay Bayou, and the mouths of adjacent streams," **1900**, 2386.

Description of, **1900**, 2386.

**Projects.**

Capt. Riché estimated, 1900, it would cost $10,000 to make the improvement as a part of an inland light-draft navigation system, **1900**, 2388.

**Surveys.**

Examination and survey ordered by act of Mar. 3, 1899, made, 1899–1900, under direction of Capt. Riché (report favorable) (see *Projects*), **1900**, 2386, 2388.

## CLEAR LAKE, CAL. (See *Red River, Ark.*)

**Engineers.**

Chief of Engineers. Report, **84**, 334.

Engineer in Charge. Lt. Col. G. H. Mendell. Report, **84**, 2210.

Assistant. Lt. C. F. Palfrey. Report, **84**, 2210.

**Physical characteristics.**

Description of, **84**, 2211.

**Survey.**

Examination ordered by act of Aug. 2, 1882, made under direction of Col. Mendell (report unfavorable), **84**, 2210.

## CLEARWATER HARBOR, FLA. (See *Cedar Keys.*)

**Commerce.**

Description, **85**, 1325, 1328.
None, **97**, 1579.

**Engineers.**

Chief of Engineers. Reports, **85**, 207; **87**, 162; **97**, 252.

Engineers in Charge:

Capt. R. L. Hoxie. Reports, **85**, 1323, 1324.
Capt. W. M. Black. Report, **87**, 1259.
Lt. Col. W. H. H. Benyaurd, 1897. Report, **97**, 1578.

Assistants:

H. Haines. Report, **85**, 1324.
J. L. Meigs. Report, **85**, 1326.
J. W. Sackett. Report, **97**, 1579.

**Physical characteristics.**

Description of; harbor a shallow sound on the west coast of Florida, about 20 miles north of the entrance to Tampa Bay, **85**, 1326; **97**, 1579.

**Plans.**

By Capt. Hoxie, 1885, dredged channel 5½ f. deep at l. w. through Sand Key Bar and Dunedin and Clearwater channels. Estimate, $11,553. **85**, 1325, 1328.

**Surveys.**

Examination ordered by acts of July 5, 1884, and Aug. 5, 1886, made under the direction of Capt. Hoxie, 1885, **85**, 1323; and Capt. Black, 1887 (report unfavorable), **87**, 1259.

Examination ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd (report unfavorable), **97**, 1579.

## CLEARWATER HARBOR TO CEDAR KEYS, FLA. (See *Cedar Keys* and *Clearwater Harbor, Fla.*)

## CLEARWATER RIVER, IDAHO.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1879, | $5,000, | **79**, | 183. |
| 1880, | 5,000, | **80**, | 2330. |
| 1882, | 5,000, | **82**, | 2678. |
| 1896, | 25,000, | **96**, | 3388. |
| 1899, | 10,000, | **99**, | 3232. |

Total, 50,000

**Commerce.**

Benefit of improvement to commerce, **79**, 1817, 1822, 1855; to timber interest, **80**, 2329.

Increasing and of growing importance, **96**, 3389.

**Contracts.**

**1880.** S. R. Smith, rock removal, $38 per c. y., **80**, 2330.

**1881.** Holmes & Chalmers, rock and stone removal, $31 and $4, respectively, per c. y., **83**, 2062.

**Engineers.**

Chief of Engineers. Reports, **78**, 139; **79**, 182, 183; **80**, 240; **81**, 329; **82**, 322; **83**, 335; **84**, 341; **85**, 371; **86**, 360; **87**, 332; **88**, 306; **96**, 416; **97**, 521; **98**, 500; **99**, 588; **1900**, 664.

Engineers in Charge:

Maj. J. M. Wilson, 1878. **78**, 138; **79**, 180, 183. Report, **79**, 1813.

Maj. G. L. Gillespie, 1879–81. **79**, 180, 183. Report, **79**, 1855; **80**, 2328; **81**, 2587.

Capt. C. F. Powell, 1881–85. Reports, **82**, 2678; **83**, 2061; **84**, 2279.

Maj. W. A. Jones, 1885–88. Reports, **85**, 2439; **86**, 1952; **87**, 2523; **88**, 2189.

Capt. H. Taylor, 1896–97. Reports, **96**, 3388; **97**, 3465.

Maj. W. L. Fisk, 1898. Report, **98**, 2989.

Capt. W. W. Harts, 1899–. Reports, **99**, 3231; **1900**, 4337.

Assistant. P. G. Eastwick, **79**, 1813. Reports, **79**, 1817; **84**, 2281.

**Operations.**

**1879–80.** Channel 60 feet wide and 4½ feet deep at low water excavated by blasting through Reubens Rapids, **80**, 2328, 2329.

**1880–81.** 97.5 c. y. solid rock and 250 c. y. cobblestone removed, **81**, 2588.

**1883–84.** 154 c. y. rock excavated, **84**, 2279.

**1896–97.** Rock removal in progress, **97**, 3465.

**1897–98.** Rock removal continued, **98**, 2990.

**Physical characteristics.**

Description of, **79**, 1814–1822, 1855; **96**, 3388.

## CLEARWATER RIVER, IDAHO—Continued.

Obstructions, **79**, 1815–1821.

Freshets, **79**, 1816, 1821, 1822.

Discharge of river, **79**, 1818, 1819, 1821.

The river is formed by the junction of the Middle and South forks; the former rising in the Bitter Root and the latter in the Salmon River mountains, and after very circuitous courses uniting about 69 miles from the mouth of the river. The river bed is of gravel, cobblestones, and bowlders, with here and there a reef of rocks extending into the channel. In 1879 numerous gravel bars and shoals existed. **96**, 3388.

**Plans.** (See *Projects.*)

By P. G. Eastwick, 1879, upper river, removal of rock and bowlders, to a depth of 3 f. at low water, **79**, 1815, 1823; considered impracticable, **79**, 1855.

By Capt. Powell, 1884, rock removal and wing-dam construction, mouth to Clearwater Forks, 40 miles; estimate, $87,000. **84**, 2280.

**Projects.**

By Maj. Wilson, 1878, removal of rock and bowlders, Lewiston to mouth of North Fork, forming a channel 60 to 75 f. wide, with a depth of 4 to 5 f. at low water; estimate, $34,424; **79**, 1816, 1823; **80**, 240; **87**, 2523.

By Capt. Taylor, 1897, revising the existing project to obtain high instead of low water navigation; estimate, $35,000; **97**, 3465.

**Surveys.**

Examination ordered and in progress, **78**, 139.

Completed by P. G. Eastwick, **79**, 183, 1813, 1817.

At Reubens Island Rapids and Kents Chute, 1883, **83**, 2061.

Survey of the river from the junction of the Middle and South forks to the mouth made by Capt. Taylor, 1896–97, **97**, 3465.

MAPS. **80**, 2328; **81**, 2588.

## CLEVELAND, OHIO. (Old river bed.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 318; **85**, 344, 2249.

ENGINEERS IN CHARGE:

Maj. J. M. Wilson, 1884. Report, **84**, 2110.

Maj. L. C. Overman, 1885. Report, **85**, 2249.

**Physical characteristics.**

Old river bed described, **84**, 2110; **85**, 2250.

**Surveys.**

Examinations ordered by act of Aug. 2, 1882, and July 5, 1884, made under the directions of Majs. Wilson (report unfavorable to immediate improvement) and Overman (report favorable), **84**, 2110; (Chf. E. report unfavorable) **85**, 2249.

## CLEVELAND HARBOR, OHIO.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1825, | $5,000.00, | act Mar. 3 (survey). |
| 1827, | 10,000.00, | **66**, iii, 33. |
| 1829, | 12,179.00, | **66**, iii, 33. |
| 1830, | 1,786.56, | **66**, iii, 33. |
| 1831, | 3,670.00, | **66**, iii, 33. |
| 1832, | 6,600.00, | **66**, iii, 33. |
| 1834, | 13,315.00, | **66**, iii, 33. |
| 1836, | 15,006.59, | **66**, iii, 33. |
| 1837, | 10,000.00, | **66**, iii, 33. |
| 1838, | 51,856.00, | **66**, iii, 33. |
| 1844, | 25,000.00, | **66**, iii, 33. |
| 1852, | 30,000.00, | **66**, iii, 33. |
| 1853, | 145.69, | **66**, iii, 33. |
| 1864, | 20,000.00, | **66**, iii, 33. |
| 1866, | 59,806.00, | **66**, iii, 33. |
| 1868, | 17,000.00, | **68**, 24 (allotment). |
| 1869–70, | [b]13,380.00, | **69**, 22. |
| 1870, | 20,000.00, | **71**, 46. |
| 1871, | [c]636.77, | **72**, 239 (allotment for repairs). |
| 1873, | $1,000.00, | **73**, 122. |
| 1874, | 30,500.00, | **75**, 151. |
| 1875, | 50,000.00, | **75**, 168. |
| 1876, | 58,000.00, | **76**, ii, 139. |
| 1878, | 100,000.00, | **78**, 130, 1263. |
| 1879, | 100,000.00, | **79**, 172, 1695. |
| 1880, | 125,000.00, | **80**, 2144. |
| 1881, | 200,000.00, | **81**, 2314. |
| 1882, | 175,000.00, | **82**, 2401. |
| 1884, | 100,000.00, | **84**, 2103. |
| 1886, | 93,750.00, | **86**, 1868. |
| 1888, | 100,000.00, | **88**, 2004. |
| 1890, | 75,000.00, | **90**, 2780. |
| 1892, | 100,000.00, | **92**, 2505. |
| 1894, | 50,000.00, | **95**, 3101. |
| 1896, | 80,000.00, | **96**, 2947. |
| 1897, | 350,000.00, | **97**, 3080. |
| 1898, | 294,000.00, | **98**, 2671. |
| 1899, | 175,000.00, | **99**, 3060. |
| 1900, | 175,000.00, | **1900**, 4068. |
| Total, | $2,746,994.84 | |

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[a] Survey.—Reports: 1825, estimate, $27,653.91; 1833, estimate, $13,315; Nov. 15, 1837, estimates, $120,350.20, $47,609.20; Oct. 14, 1865, estimate, $59,806. (H. Doc. No. 482, 55th Cong., 2d session.)

[b] Said to be $12,000, **69**, 137.

[c] Difference between $1,000 and the amount which reverted to the Treasury.

## CLEVELAND HARBOR, OHIO—Continued.

**Commerce.**

Important, **67**, 252, 253, 254.

Report of Board of Industry upon development of lake commerce and necessity for increased harbor facilities, **88**, 2008.

Description of, **96**, 2950; **98**, 2728–2731.

Large shipments of coal, **96**, 2947; more than 7,000,000 tons of freight carried in 1896, **96**, 2950.

Large and increasing, **98**, 2670; **1900**, 4067.

**Contracts.**

**1866.** J. E. & D. E. Bailey, stone and labor, **66**, iii, 74; **67**, 142. Patrick Smith, piles, **66**, iii, 74; **67**, 142. J. D. Palmer & Wright, timber and lumber, **66**, iii, 74; **67**, 142. James Loveday, iron, **66**, iii, 74; **67**, 142.

**1871.** A. Spaulding, dredging, 25 cents per c. y., **71**, 194; **72**, 229.

**1874.** Hemmingway & Garfield, materials and labor. **75**, 303. Cartwright, McCurdy & Co., iron, **75**, 303.

**1875.** C. H. Strong, materials and labor, **76**, ii, 559. W. H. McCurdy, iron, **76**, ii, 559.

**1877.** W. H. McCurdy, iron, **77**, 964. Ferris & Garfield, materials and labor, **77**, 964; **79**, 1697.

**1878.** W. H. McCurdy, iron, **79**, 1697. F. H. Colton, timber and labor, **79**, 1697.

**1879.** C.H. Strong, timber and labor, **79**, 1697. O. Sherwood and J. Geissendorfer, breakwater construction, **80**, 2145. G. Worthington & Co., iron, **80**, 2145.

**1880.** P. Smith, dredging, 30 cents per c. y., **80**, 2146. J. Barrett, iron, **81**, 2314. J. C. Williams, breakwater construction, **81**, 2315.

**1881.** J. Stang, pile protective works, **81**, 2315. C. G. Hubbell, iron, **81**, 2316. Sherwood, Strieberger & Geissendorfer, material and workmanship, **81**, 2317.

**1882.** W. H. McCurdy, iron, **83**, 1909. L. P. & J. A. Smith, materials and labor, **83**, 1910. W. P. Stanton, driftbolts and boat spikes, $2\frac{6}{10}$ cents and $2\frac{8}{100}$ cents per pound, respectively, **83**, 1910.

**1884.** J. Stang, repair of lake arm of breakwater, **85**, 2232.

**1885.** L. P. & J. A. Smith, filling stone, $5.50 per cord, **86**, 1868.

**1886.** L. P. & J. A. Smith, foundation stone for breakwater, **87**, 2318, 2322.

**1887.** L. P. & J. A. Smith, breakwater construction, **87**, 2318, 2322. B. S. Horton construction of breakwater parapet, **87**, 2319, 2322.

**1888.** W. M. Pattison, driftbolts and spikes, 2½ cents per pound, **89**, 2323. Kelley Island Lime and Transport Co., furnishing and placing foundation stone, $4.89 per cord. J. B. Donnelly, furnishing stone and timber, $65,268, **89**, 2324. A. Lacour, iron, $3,926, **89**, 2324.

**1890.** Kelley Island Lime & Transport Co., furnishing stone, $10,680, **91**, 2857. L. P. & J. A. Smith, breakwater extension, $47,954, **91**, 2857. W. M. Pattison, iron, $3,147, **91**, 2857. Carkin, Stickney & Cram, dredging, 25 cents per c. y., **91**, 2859.

**1892.** L. P. & J. A. Smith, construction of breakwater, approximate total of bid, $59,825.37, **93**, 3080.

**1893.** Sadler & Allen, dredging, 14 cents per c. y., **93**, 3080.

**1896.** J. B. Donnelly, construction of east pier, approximate total of bid, $27,484.77, **96**, 2948.

**1897.** Hunkin Bros., repair of breakwater, approximate total of bid, $413,843.78, **97**, 3081.

**1898.** J. B. Donnelly, furnishing stone in place for foundation of east breakwater, 92 cents per ton, **98**, 2671.

**1899.** W. A. McGillis & Co., dredging, 11.95 cents per c. y. (70,000), **99**, 3063.

**Documents.** (Not printed in reports.)

All details of projects and operations prior to 1864. Reports of Col. T. J. Cram, dated Nov. 2, 1864, **66**, 24; and Feb. 1, 1867, **66**, iv, 142.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 5, ii, 37, 41, iii, 5, 33, iv, 20; **67**, 29, 30, 252; **68**, 24, 41; **69**, 22, 37; **70**, 48; **71**, 46; **72**, 44; **73**, 44, 46, 122; **74**, 50, 53; **75**, 55, 57, 151, 168; **76**, 108, 139, ii, 559; **77**, 114, 115; **78**, 129, 130; **79**, 172; **80**, 226; **81**, 309; **82**, 304; **83**, 312; **84**, 315; **85**, 340, 2232, 2233; **86**, 344; **87**, 300; **88**, 274, 2005; **89**, 325; **90**, 294; **91**, 370; **92**, 349; **93**, 400; **94**, 375; **95**, 409; **96**, 363; **97**, 458; **98**, 447, 455; **99**, 530, 536; **1900**, 595, 604.

BOARDS OF ENGINEERS.

1875. To consider the subject of a breakwater; various plans discussed. Recommend a closed breakwater with an area of 200 acres. Adjourned to await examination of the lake bed, **75**, 308. Reassembled and selected the west side of the city front for its location, and recommend its construction to be as follows: West side, 1,000 f. of pile pier from shore line to 15 f. of water, thence 1,400 f. of crib work extending to 27 f. water. North side, 4,700 f. of crib work nearly parallel with the shore. East side, extension of the west harbor pier 600 f., leaving an entrance 300 f. in width to the new harbor. Estimate, $1,373,000. Report, **75**, 308. (Col. Woodruff, Lt. Col. Blunt, Majs. Comstock and Wilson.)

Constituted by S. O. No. 98, 1884, Corps of Engineers (Lt. Cols. McFarland and Wilson and Maj. Overman), **85**, 2234.

## CLEVELAND HARBOR, OHIO—Continued.

ENGINEERS IN CHARGE:

Col. T. J. Cram, 1864–68. Reports, **66**, 13, 22, 24, 45, iv, 19–25, 69–75; **67**, 41, 48, 230–233.

Maj. W. McFarland, 1868–70. Reports, **68**, 155; **69**, 133; **70**, 178.

Capt. G. L. Gillespie, 1870–72. **71**, 45. Reports, **71**, 193; **72**, 229.

Maj. F. Harwood, 1872–74. **73**, 42. Reports, **73**, 337; **74**, 222. On survey for harbor of refuge, **74**, 232–238.

Lt. Col. C. E. Blunt, 1874–77. **77**, 215. Reports, **75**, 302, 304; **76**, ii, 558; **77**, 963, 964.

Maj. W. McFarland, 1878. Reports, **78**, 1261, 1263.

Maj. J. M. Wilson, 1878–83. Reports, **79**, 1691; **80**, 2135; **81**, 2310; **82**, 2398.

Maj. L. C. Overman, 1883–92. Reports, **83**, 1905; **84**, 2097; **85**, 2227; **86**, 1863; **87**, 2317; **88**, 2001, 2006; **89**, 2319; **90**, 2777; **91**, 2853.

Lt. Col. J. A. Smith, 1892——. Reports, **92**, 2503; **93**, 3075; **94**, 2409; **95**, 3100; **96**, 2939; (Col.), **97**, 3075; **98**, 2661, 2724; **99**, 3057, 3075; **1900**, 4063.

ASSISTANTS:

Maj. F. U. Farquhar. Estimates by, **66**, iv, 19, 71.

Capt. M. B. Adams, **75**, 53. In immediate charge of harbor, **75**, 292, 304.

G. E. Fell, **74**, 233.

F. S. Burrows. Report, **98**, 2675.

W. T. Blunt. Report, **98**, 2732.

**Estimates.** (See *Plans* and *Projects*.)

By Col. Cram, proposed extension, $59,806, **66**, 23, iv, 73; additional to complete existing project, $3,691; additional for channel for vessels drawing 14 f. water, $130,000, **67**, 252.

By Maj. Harwood, breakwater for harbor of refuge, $500 per l. f.; aggregate, $4,000,000, **74**, 237.

By Lt. Col. Blunt, breakwater in 4-fathom water, $521,000; in 5-fathom water, $1,155,000, **75**, 305, 306.

By Board of Engineers, breakwater, $1,373,000; softness of the lake bed might increase the cost 25 per cent, **75**, 310.

By Chief of Engineers, modified to $1,800,000, **75**, 303. To complete existing project, $1,500,000, **79**, 173, 1695.

**Legal proceedings.**

Part of project delayed because of difficulty in obtaining necessary land, **97**, 3078; **98**, 2666; **1900**, 4067.

**Obstructions.**

Filling of harbor, 1900, preventable, **99**, 3078.

**Operations.**

**1865.** Repairs to west pier, **66**, 22.

**1867–68.** 450 l. f. of west pier built, **68**, 41.

**1868–69.** 5 f. added to west and 400 f. to east pier, **69**, 133.

**1869–70.** 175 f. added to east pier, making the piers of equal length; west pier repaired, **70**, 178.

**1870–71.** Repairs to east pierhead, dredging 9,500 c. y., **71**, 47.

**1871–72.** 65,664 c. y. sand and gravel removed; east and west piers repaired by day labor, **72**, 229.

**1874.** Repairs to piers, **74**, 222.

**1875–76.** Repairs to piers by contract, **75**, 303. Repairs to east pier in progress, **77**, 964. 333 f. of pile pier for breakwater completed, **76**, ii, 558.

**1876–77.** 1,150 f. of pile pier nearly completed, **77**, 964.

**1877–78.** Substructure of breakwater extended 300 f. by 6 cribs, each 50 f. long; repairs to east pier, **78**, 129, 130, 1261, 1263.

**1878–79.** 600 l. f. of crib work sunk, 500 l. f. of superstructure built, and stone foundation prepared for 1,000 l. f. of crib work for breakwater; repairing piers and dredging at the mouth of the river, **79**, 172, 1693.

**1879–80.** 800 l. f. crib work sunk, 1,054 l. f. superstructure built, 208 c. y. stone placed in pile portion of breakwater, 550 l. f. foundation completed upon new breakwater, **80**, 2142; 737 l. f. west pier superstructure rebuilt, 80 l. f. east pier repaired, 12,802 c. y. dredged at mouth of Cuyahoga River, **80**, 2143.

**1880–81.** Method of breakwater construction: 700 l. f. crib work sunk and 700 l. f. of superstructure built, **81**, 2312.

**1881–82.** 620 l. f. pile protection built, repairs to 541 l. f. of east pier and 500 l. f. of west pier, 700 l. f. superstructure filled with stone, 350 l. f. riprapped with heavy stone, 1,800 l. f. foundation completed, 1,100 l. f. crib work, **82**, 2399, 2400. Abstract of materials used in construction of 1,004 l. f. of breakwater, **82**, 2403.

**1882–83.** Repairs to U. S. boathouse, 4,000 c. y. dredged between piers, minor repairs to new breakwater, 950 l. f. foundation built, 1,600 l. f. crib work sunk, 1,350 l. f. superstructure completed, **83**, 1906, 1907, 1908.

**1883–84.** 21,122 c. y. dredged from between piers, repairs to breakwater injured by collision, repairs to settled part of breakwater, 505 l. f. foundation built, 950 l. f. crib work placed, 1,900 l. f. of breakwater riprapped, 1,912 l. f. superstructure built, **84**, 2098, 2099, 2100, 2101. Project of 1875 completed, **85**, 2228.

**1884–85.** 163 l. f. decking of east pier renewed, 80 f. of decking of west pier renewed. Repairs to east pier cribs, repairs to U. S. Engineers' boathouse,

## CLEVELAND HARBOR, OHIO—Continued.

repairs to breakwater, junction of crib top, and lower course of superstructure closed by boiler-iron plating, **85**, 2228, 2229.

**1885–86.** 988 cords stone placed in lake-arm superstructure, **86**, 1864. 150 cross-ties spliced and replaced, 2,120 tons stone placed in breakwater, **86**, 1865.

**1886–87.** Progress on formation of foundation of breakwater, repairs to piers and breakwater, **87**, 2318.

**1887–88.** Foundation of 1,200 l. f. of breakwater completed by the deposit of 4,620 cords of stone; 600 l. f. of breakwater parapet and superstructure completed; 3,530 l. f. of parapet wall built; repairs to piers and superstructure by hired labor, **88**, 2002, 2003.

**1888–89.** Superstructure placed on 7 cribs by hired labor; 7 cribs placed and filled under contract; repairs to piers and breakwater by hired labor, **89**, 2320, 2321.

**1889–90.** 550 l. f. of breakwater completed under contract; repairs to piers by hired labor; 3,256 c. y. dredged, **90**, 2778.

**1890–91.** 13,300 c. y. dredged from channel between the piers and from breakwater basin; extension of east breakwater begun, **91**, 2854.

**1891–92.** 4,786 c. y. dredged; repairs to breakwater, **92**, 2503.

**1892–93.** 4,252 c. y. dredged, **93**, 3076, dredging in progress, and extension of east breakwater in progress, **93**, 3077.

**1893–94.** In connection with previous year, 142,998 c. y., s. m., dredged, and 450 l. f. east breakwater extended, **94**, 2410.

**1894–95.** West breakwater repaired, **95**, 3105, removal of 200 l. f. of west breakwater in progress, **95**, 3104, and harbor line on the east side of the river changed, **95**, 3105.

**1895–96.** Opening of west breakwater, commenced in previous year, completed, **96**, 2940, and 11,033 c. y. dredged, **96**, 2941.

**1896–97.** Old east pier removed and replaced with new pier, **97**, 3075, 64,323 c. y. dredged, and repairs made to breakwater, **97**, 3077.

**1897–98.** Repair of west breakwater in progress, **98**, 2662, storehouse erected on west pier, small steamer purchased, and extension of east breakwater in progress, **98**, 2664, 2665.

**1898–99.** Concrete superstructure of west breakwater under construction; foundation of riprap stone for east breakwater extension completed; 15,648 c. y. dredged; construction of part of west pier in progress; damaged works repaired (photographs), **99**, 3057.

**1899–1900.** Concrete superstructure of west breakwater in progress of construction (photographs; sketch map); completion of east breakwater and reconstruction of west pier in progress; repairs made to old west breakwater; 520,792 c. y. dredged (photographs), **1900**, 4062.

**Physical characteristics.**

The depth of water on the outer bar diminished 5 f. during violent storms, **71**, 194.

Character of lake bottom, **75**, 304.

Description of, **74**, 233; **75**, 309; **93**, 3077; **94**, 2410; **95**, 3102; **97**, 3078; **98**, 2665, 2669, 2670, 2726.

In 1897 the officer in charge did not deem it advisable for physical reasons to abandon the construction of the shore arm of the breakwater, as at that time planned, **98**, 2725.

Storms damaging works (photographs), **1900**, 4065.

**Plans.** (See *Estimates* and *Projects.*)

Sketches of, suggested for a harbor of refuge by Board of Trade of Cleveland, **74**, 234.

By P. C. Watmough and Maj. Harwood, **74**, 235.

By Lt. Col. Blunt and Maj. Harwood, **75**, 306.

Discussion of pile piers, **66**, iv, 19, 20, 69–72; **68**, 156; **69**, 133–136; **73**, 338.

**Private (city and corporate) work.**

Dredging by the city on bar, **66**, 22.

East pier in possession of private parties, **66**, 22, 23, ii, 37.

The Cleveland and Pittsburgh R. R. Co. permitted to use a portion of the east pier, agreeing to keep it in repair, **77**, 965.

Dredging by city of Cleveland, **90**, 2778; **94**, 2410.

**Projects.** (See *Estimates* and *Plans.*)

Original piers at mouth of Cuyahoga River and dredging; details not known (see map), **66**, 23.

By Col. Cram, repairs of piers, **66**, 13, 22. Extension of west pier 500 f. and east pier 575 f., 18 f. wide and 5 f. above water, **66**, 23. Pile-pier construction adopted for pier extension instead of cribs, **66**, iii, 5, 20.

By Maj. Gillespie, repairs of piers by day labor, and dredging to 18 f. by contract, **71**, 193, 194; completed, **72**, 229.

By Maj. Harwood, repairs to piers by day labor, **73**, 337; **74**, 222.

By Lt. Col. Blunt, repairs to east pier, **77**, 965.

By Board of Engineers, as finally adopted, **75**, 303.

## CLEVELAND HARBOR, OHIO—Continued.

By Lt. Col. Blunt, shore arm of breakwater by contract as far as available funds would allow, **75**, 303.

By Board of Engineers, 1875, breakwater on west side of mouth of Cuyahoga River; estimate, $1,800,000, **80**, 2141, 2143; **85**, 2228. Modification by Chief of Engineers, **75**, 303; **80**, 2141. Completed in 1883, at a cost of $800,000, **85**, 2228. Modified in 1884 by Board of Engineers, by an additional breakwater with a parapet; estimate, $500,000, **85**, 2235; **87**, 2317, 2319. Amount required, in 1888, for completion of the above project, including the appropriation of 1888, $219,250.

In 1888 Maj. Overman proposed to extend the lake arm of the east breakwater from about 1,100 f. to 3,500 f. in length, then incline toward the shore on a line parallel with the present projected breakwater, and construct 2,000 l. f. of breakwater, making a total of 5,500 l. f. for the east breakwater, and increasing the anchorage space beyond the 16-f. curve from 75 to 200 acres. Estimate, proposed extension, $300,000. Total in 1888, for completion of original and revised project, $519,250, **88**, 2004, 2006.

By Lt. Col. Smith, 1892, for dredging a channel and approach to anchorage, and for the extension of the breakwater, at a cost of about $25,000, **93**, 3076.

In 1892-93 Lt. Col. Smith estimated, after revising the existing project, that it would cost $568,000 to improve the harbor, **93**, 3078.

By Lt. Col. Smith, 1894, removal of 200 f. of the superstructure of west breakwater, that currents might pass through west anchorage to remove and prevent settlements of sewage, at an estimated cost of $5,000, **95**, 3104.

By Lt. Col. Smith, 1895-96, rebuilding the east pier as far as could be done with available funds, the substructure to be built of cribwork filled with stone and the superstructure of concrete masonry, **95**, 3105.

By Lt. Col. Smith, 1896, renewing 322 l. f. of the east pier and 1,478 l. f. of the west pier; widening the channel to 260 f. for dredging; construction of 5,440 l. f. west breakwater, and sheathing faces of cribs of east breakwater; estimate, $860,000, **96**, 2946, 2952.

By Col. Smith, 1898-99, deepening the harbor to 21 f. between piers north of the railroad bridge, and from the harbor line to a line 50 f. from the breakwater and to 25 f. over shoal at entrance on the east; estimate, $181,000. Estimate, 25-f. depth instead of 21, $368,000 (not adopted). **99**, 3077.

Breakwaters of stone commended, **1900**, 4065.

(See *Legal proceedings.*)

### Secretary of War.

Approves recommendation of Chief of Engineers for project for harbor of refuge, **75**, 308.

Authorized by act approved Aug. 14, 1876, to make agreement with railroad company for use and occupancy of the east pier, **76**, ii, 139.

### Surveys.

Under direction of Col. Raynolds, 1865, **66**, 25.

For harbor of refuge, 1873, under direction of Maj. Harwood, by G. E. Fell. Report, **74**, 232.

For breakwater, 1874, under direction of Lt. Col. Blunt. Report, **75**, 304.

Of channel between piers, 1881, **81**, 2311.

Examination, 1885, of condition of superstructure of breakwater, **86**, 1864.

Hydrographic survey made in 1892 under direction of Lt. Col. Smith, **93**, 3076; one of the channel breakwater to the Lake Shore and Michigan Ry. bridge, made by the same officer in 1895, **95**, 3105.

Entire bottom of the west side of the harbor, shore line to the breakwater, examined in 1895-96 under direction of Lt. Col. Smith, **96**, 2942.

Survey of the breakwater at the harbor with a view to determining the advisability of changing the plan therefor so as to abandon the proposed construction of the eastern shore arm, and in lieu thereof extending the breakwater eastwardly in a general direction parallel with the shore, ordered by act of June 3, 1896, made under direction of Col. Smith in 1897, **98**, 2724.

Minor surveys, **99**, 3059.

Concurrent resolution of Congress, December, 1899, called for a report on the necessity and the probable cost of partly restoring the harbor depths. Report submitted by Col. Smith (see *Projects*), **99**, 3075.

MAPS.

Northern and northwestern lakes, showing location of improvements, **66**, 24.

Harbor, showing condition of, in 1865, **66**, 24.

Sketches of proposed harbor of refuge, **74**, 235; **75**, 306.

**81**, 2310; **82**, 2400; **88**, 2006, 2010; **91**, 2856; **94**, 2412; **95**, 3106; **96**, 2952; **97**, 3080; **98**, 2676 (photographs, **99**, 3059; **1900**, 4068).

## CLINCH RIVER, TENN. AND VA. (See *Emory River, Tenn. and Va.*)

**Appropriations.**

1880, $10,000, **80**, 1680.
1881, 3,000, **81**, 1864.
1882, 3,000, **82**, 1851.
1884, 5,000, **84**, 1651.
1886, 5,000, **86**, 1522.
1888, 5,000, **88**, 1609.
1890, 4,000, **90**, 2132.
1892, 4,000, **92**, 1927.
1894, 2,500, **95**, 2320.
1899, 8,500, **99**, 2305.

Total, 50,000

**Commerce.**

Value of farm products exported, $2,000,000, **76**, 741, 745.

In 1893 about 78 per cent of the logs reaching Chattanooga came by this river and its tributaries, **93**, 2388.

Business on the river done at high or intermediate stages, **98**, 1944.

1898, 160,000 tons, annually, 1898, valued at about $865,000, **1900**, 3067.

**Engineers.**

Chief of Engineers. Report, **76**, 87; **80**, 187, 190; **81**, 253, 258; **82**, 246; **83**, 254; **84**, 255; **85**, 277; **86**, 268; **87**, 233; **88**, 209; **89**, 244; **90**, 220; **91**, 281; **93**, 303; **94**, 277; **95**, 315; **96**, 273; **97**, 353; **98**, 346; **99**, 408; **1900**, 465, 469.

Engineers in Charge:

Maj. W. McFarland, 1876. **76**, 87. Reports, **76**, 741, 745.

Maj. W. R. King, 1880–86. Reports, **80**, 1680; **81**, 1862, 1864; **82**, 1850; **83**, 1495; **84**, 1651; **85**, 1766.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86**, 1521; **87**, 1755; **88**, 1606; **89**, 1835; **90**, 2131; **91**, 2264.

Lt. Col. H. M. Robert, 1892. Report, **92**, 1925.

Capt. J. Biddle, 1893–94. Reports, **93**, 2387; **94**, 1801.

Capt. T. A. Bingham, 1895. Report, **95**, 2318.

Capt. D. C. Kingman, 1896–. Reports, **96**, 2058; **97**, 2311; (Maj.), **98**, 1943; **99**, 2303; **1900**, 2948, 3065.

Assistants:

W. M. Gordon. Report, **76**, 742.
E. C. Tollinger. Report, **81**, 1865.
E. R. Nelles. Report, **98**, 1946.

**Legislation.**

State of Tennessee in reference to "fish traps" in the Clinch River, **88**, 1608.

**Operations.**

**1880–81.** 549 c. y. rock excavated; 140 c. y. rock placed in wing dams, and 248 snags and trees removed, **81**, 1863.

**1881–82.** 2,556 c. y. rock removed; 1,686 c. y. dam built, and 586 snags removed, **82**, 1850.

**1882–83.** 1,816 c. y. rock removed; 1,624 c. y. gravel excavated; 1,526 c. y. earth embankment, and 4,666 c. y. of riprap dam built, **83**, 1496.

**1883–84.** 95 c. y. rock and 700 c. y. gravel removed; 106 c. y. stone put in dams, **84**, 1651.

**1884–85.** 11,476 c. y. rock, sand, and gravel excavated; 398 l. f. timber cribs and 3,812 c. y. stone dams constructed; 233 trees and snags removed, **85**, 1767.

**1887–88.** 540 c. y. rock and gravel excavated; 715 c. y. riprap quarried; 1,309 c. y. of dam and 30 l. f. of crib work built, **88**, 1607.

**1888–89.** 224 c. y. rock excavated; 1,160 c. y. riprap quarried; 889 c. y. riprap dam built, **89**, 1836.

**1889–90.** 80 l. f. of crib dam built; 528 c. y. stone placed in dams, and 28 overhanging trees cut, **90**, 2132.

**1890–91.** Removal of obstructions and dam construction continued, **91**, 2265.

**1891–92.** 544 c. y. rock excavated, and 875 c. y. rock used in construction of wing dams at Llewellyn and Youngs Island shoals, **92**, 1926.

**1893–94.** About 60 c. y. loose rock removed from channel and placed on riprap dam, **94**, 1803.

**1897–98.** 6,547 c. y. rock blasted; 4,602 c. y. gravel and other material removed; nearly 1,000 obstructions removed, **98**, 1945.

**1898–99.** About 1,500 obstructions removed from river, **99**, 409.

**1899–1900.** About 4,000 c. y. of bowlders and ledges excavated; 1,600 c. y. dams built; 392 c. y. bank riprapped, and 1,220 snags and other obstructions removed from river, **1900**, 2951.

**Physical characteristics.**

Description of, **76**, 741, 742, 743; **88**, 1606; **1900**, 3066.

Obstructions, **76**, 743.

Detailed description of the location and nature of the obstructions removed in 1897–98, **98**, 1947.

Table showing discharge observations, **1900**, 3066.

**Plans.** (See *Projects.*)

By Maj. McFarland, 1876, high-water channel from 3 to 4 f. deep with wing dams and by removing obstructions; estimate, $44,025, **76**, 742,744. Slackwater navigation possible, but the interests of commerce would not justify the expense, **76**, 747.

By Maj. King, 1881, Nashs Ford to Haynes, with wing dams and by removing obstructions; estimate, $24,510, **81**, 1867.

## CLINCH RIVER, TENN. AND VA.—Continued.

**Private (State and Corporate) Work.**

Tennessee expended, 1845, $10,000 in removing obstructions between State line and mouth of river; work unsatisfactory, **76**, 743.

The Clinch River Improvement Co. expended $1,000, 1872, with good results, **76**, 743.

**Projects.** (See *Plans.*)

By Maj. McFarland, 1876, high-water channel 1½ to 2 f., mouth to Haynes (or Walkers) Ferry, 145 m., with wing dams and by removing obstructions for 230 miles; estimate, $26,400, **76**, 737; **80**, 1680.

After an expenditure of $21,000, the estimate was increased by Maj. King, 1885, to $50,000, **85**, 1767; **87**, 1755, 1757; **91**, 2265.

By Capt. Kingman, 1896–97, for expending available funds to remove obstructions, Osborne, head of navigation, to the mouth, **97**, 2313.

Act of March 3, 1899, provided that as much of the appropriation for improving Tennessee River between Chattanooga and Riverton as might be necessary could be used for survey, Clinch River; $4,800 was allotted for surveying the Clinch River from Haynes (Walkers Ferry) to its mouth, **99**, 2304.

$3,000 allotted from appropriation 1899 to remove obstructions to lengthen the navigation season, **99**, 2305; $3,000 to be applied, together with other allotments from certain appropriations, to constructing a light-draft dipper dredge, for use on the Upper Tennessee River, the Clinch, and certain other tributaries, **1900**, 2950.

**Surveys.**

Examination, mouth of Indian to junction of Clinch and Powells rivers, **76**, 87, 745.

By W. M. Gordon, below Emorys River, **76**, 87, 745.

Ordered by act of June 14, 1880, made, 1881, under direction of Maj. King, **81**, 1864.

Survey ordered by act of March 3, 1899, made, 1899, by Maj. Kingman, (preliminary report favorable), **1900**, 3066.

## CLINTON, IOWA. (See *Mississippi River.*)

## CLINTON HARBOR, CONN.

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $3,000, | **83**, 512. |
| 1890, | 3,500, | **90**, 617, |
| 1892, | 2,000, | **92**, 668. |
| Total, | 8,500 | |

**Commerce.**

Important, **82**, 631.

**Contracts.**

**1883–84.** D. V. Howell, riprap dike construction, $1.41 per ton, **84**, 644.

**1892–93.** Hartford Dredging Co., dredging, 10,500 c. y., at 28½ cents per c. y., **93**, 918.

**Engineers.**

Chief of Engineers. Reports, **81**, 97; **82**, 97; **83**, 88; **84**, 94; **85**, 83; **86**, 83; **87**, 46; **88**, 47; **89**, 59; **90**, 54; **91**, 66; **92**, 71; **93**, 76; **94**, 68.

Engineers in Charge:

Maj. J. W. Barlow, 1881–83. Report, **82**, 630.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 511; **84**, 643; **85**, 643.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 634; **87**, 596; **88**, 538; **89**, 669; **90**, 616; **91**, 759; **92**, 667.

Lt. Col. H. M. Robert, 1893–94. Reports, **93**, 917; **94**, 640.

Assistant. H. N. Babcock. Report, **82**, 630.

**Operations.**

**1883–84.** 375 f. of riprap dike built, **84**, 643.

**1890–91.** 836 tons of riprap granite used in extension of dike, **91**, 760.

**1892–93.** 10,500 c. y. dredged, and project completed, **93**, 918.

**Physical characteristics.**

Description of, **88**, 538.

**Projects.**

By Maj. Barlow, 1882, closing the breach with a riprap stone dike, and if the desired depth was not restored by the increased tidal flow, to dredge channels 100 f. wide and 6 f. deep at m. l. w. through the two shoals; estimate, dike, $3,000; dike and dredging, $10,000, **82**. 630; **86**, 634; **87**, 596; **92**, 667.

By Lt. Col. Robert, 1893, modified project providing for a width of 75 f.; total estimate, $8,500, **93**, 917.

**Survey.**

Ordered by act of March 3, 1881; made, 1882, under direction of Maj. Barlow, **82**; 630.

Maps. **83**, 511; **86**, 634.

## CLINTON RIVER, MICH.

**Appropriations.**

1852, $5,000, **66**, 7.
1870, 5,000, **70**, 46.
1871, 1,500, **71**, 182.
1881, 8,000, **81**, 2254.
1882, 6,000, **82**, 2338.
1886, 6,000, **86**, 1842.
1888, 10,000, **88**, 1974.
1890, 10,000, **90**, 2744.
1892, 8,564, **92**, 2478.
1894, 5,000, **95**, 2838.
1896, 10,000, **96**, 2737.

Total, 75,064

**Commerce.**

Local and unimportant, **72**, 214; **76**, ii, 549.

Small, **95**, 2838.

**Contracts.**

**1870.** J. Brown, dredging, 22 cents per c. y., **70**, 161; **71**, 181, 182.

**1881.** Dupuis, Johnston & Co., dredging, $5.40 per hour, **81**, 2254.

**1882.** T. M. Hubbell, dredging, 20 cents per c. y., **83**, 1882. Carkin, Stickney & Cram, material and labor, **83**, 1882.

**1888.** Hubbell & Skeldon, furnishing dredge and tug, $6.45 per hour, **88**, 1974.

**1889.** Hubbell & Skeldon, revetment construction and dredging, $9,756.16, **90**, 2744.

**1891.** G. Lockerbie, dredging, 23½ cents per c. y., **91**, 2789.

**1893.** M. Steiner, revetment construction; total, $6,559.21, **93**, 2945.

**1897.** E. Hall, dredging, 15 cents per c. y., s. m., **97**, 3028.

**Engineers.**

Chief of Engineers. Reports, **66**, 7; **70**, 46; **71**, 44; **72**, 41; **76**, 106; **79**, 170; **80**, 221; **81**, 300; **82**, 294; **83**, 304; **84**, 307; **85**, 330, 332; **86**, 325; **87**, 293; **88**, 265; **89**, 316; **90**, 286; **91**, 358; **92**, 341; **93**, 386; **94**, 359; **95**, 393, 397; **96**, 349; **97**, 449; **98**, 436; **99**, 519; **1900**, 583.

Engineers in Charge:

Maj. O. M. Poe, 1870. **70**, 159.

Maj. G. Weitzel, 1870–76, **73**, 40. Reports, **70**, 159, 161, 162; **71**, 180; **72**, 214; **76**, ii, 259.

Maj. F. Harwood, 1880–83. Reports, **80**, 2062; **81**, 2253; **82**, 2337.

Lt. Col. O. M. Poe, 1883–92. Reports, **83**, 1880; **84**, 2074; **85**, 2165, 2190, 2192; **86**, 1842; **87**, 2265; **88**, 1973; (Col.), **89**, 2270; **90**, 2742; **91**, 2788; **92**, 2477.

Maj. W. Ludlow, 1893. Report, **93**, 2942.

Lt. Col. G. J. Lydecker, 1894–. Reports, **94**, 2254; **95**, 2837–2857; **96**, 2736, **97**, 3027; **98**, 2595; **99**, 3001; **1900**, 3996.

Assistants:

H. A. Ulffers. Reports, **72**, 214; **76**, ii, 549.

B. H. Muehle. Reports, **80**, 2063; **85**, 2193.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Poe, dredging channel from mouth of river, $5,000, **70**, 161, 162; **71**, 180.

**Operations.**

**1870.** 20,454 c. y. dredged, making a channel 2,700 f. long, 98 f. wide, and 9 f. deep, **70**, 161; **71**, 181, 182.

**1881–82.** 2,700 l. f. of channel 60 f. wide and 8 f. deep dredged, 38 piles driven, and 600 f. mattress placed in bank protection, **82**, 2337.

**1882–83.** 800 l. f. brush mattress sunk, 23 pile clusters driven; pile crib constructed at terminus of line of piles; 3,275 brush bundles and 23 cords stone placed in pile crib; 6,123 c. y. sand dredged, **83**, 1880, 1881.

**1886–87.** Appropriation held until authority to purchase the necessary right of way be granted, **87**, 2266.

**1887–88.** Dredging of channel under contract begun, **88**, 1973.

**1889–90.** 8,169 c. y. dredged, **90**, 2743.

**1890–91.** 25,906 c. y. dredged, completing the removal of shoals at Green Fence, Tets and Fortons bends, and Reimolds Bar, **91**, 2788.

**1891–92.** 23,374 c. y. dredged, **92**, 2477.

**1892–94.** Two sections of training dike on the north side of the entrance to the river built, **93**, 2943; **94**, 2254.

**1896–97.** 8,655 c. y., s. m., dredged, **97**, 3027.

**1897–98.** 25,708 c. y., s. m., dredged, **98**, 2595.

**Physical characteristics.**

Description of, **72**, 214; **76**, ii, 549.

Shoaling of dredged channels, **99**, 3001.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Poe, for a curved channel, with banks protected by wild rice, **72**, 214.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Poe, 1870, dredging channel of entrance 100 f. wide, 2,700 f. long, and 8 f. deep. Estimate, $5,000, **71**, 180; **81**, 300.

## CLINTON RIVER, MICH.—Continued.

By Maj. Harwood, 1880, below Mount Clements, excavation of channel 100 f. wide by 8 f. deep and construction of pile revetments. Estimate, $25,000. **80**, 2063.

By Lt. Col. Poe, 1885, entrance, dredging 3,400 f. of channel 100 f. wide and 10 f. deep, and construction of 3,280 l. f. of pile revetment, and repairs to pile crib. Estimate, $32,926. **85**, 2193, 2195; **86**, 325; **91**, 2788.

By Lt. Col. Lydecker, 1899, for applying available funds to redredging entrance channel and to reenforcing and extending an old dike adjoining the entrance, **99**, 3001.

**Surveys.**

Under direction of Maj. Poe, by H. A. Ulffers, Oct., 1871. Report, **72**, 214.

Ordered by act approved Mar. 3, 1875; assigned to Maj. Weitzel, **76**, 106; made by H. A. Ulffers. Report, **76**, ii, 549.

Resurvey in progress, under direction of Maj. Harwood, **79**, 170.

Resurvey, 1880, ordered by act of Mar. 3, 1879, made under direction of Maj. Harwood, **80**, 2062.

Survey, 1885, ordered by act of July 5, 1884, made under direction of Lt. Col. Poe, **85**, 332.

Minor surveys, **95**, 2838; **99**, 3001; **1900**, 3996.

MAPS.

Of northern and northwestern lakes, showing location of improvement, **66**, i; **82**, 2338.

**CLUBFOOT RIVER, N. C.** (See *New Berne to Beaufort, N. C., inland line of navigation.*)

## COAL RIVER, W. VA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 253.

ENGINEER IN CHARGE. Lt. Col. W. P. Craighill. Report, **87**, 1929.

ASSISTANT. W. C. Reynolds. Report, **87**, 1929.

**Physical characteristics.**

Description, **87**, 1929.

**Survey.**

Examination ordered by act of Oct. 4, 1886, made, 1887, under direction of Lt. Col. Craighill (report unfavorable), **87**, 1929.

**COANJOCK BAY, NORTH RIVER BAR, AND CURRITUCK SOUND, N. C.** (See *Currituck Sound, Coanjock Bay,* and *North River Bar, N. C.*)

## COASTER HARBOR ISLAND, R. I.

**Appropriation.**

1890, $5,500, **91**, 719.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 56; **90**, 51; **91**, 57; **92**, 60; **93**, 63.

ENGINEERS IN CHARGE:

Maj. W. R. Livermore, 1888–92. Reports, **90**, 590, 591; **91**, 718.

Capt. W. H. Bixby, 1892–93. Report, **92**, 624; **93**, 835.

**Operations.**

**1890–91.** 31,281 c. y. dredged, **91**, 718.

**1891–92.** Work of cutting through the causeway and erecting bridges begun, **92**, 625.

**1892–93.** Project completed, **93**, 836.

**Physical characteristics.**

Description of, **93**, 835.

**Project.**

By Maj. Livermore, 1889, dredging the cove, and making two additional openings in the causeway, spanned by wooden bridges; estimate, $5,500, **90**, 591.

**Survey.**

Survey ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Livermore, **90**, 591.

MAPS. **93**, 836.

## COBESSECONTE CANAL, ME.[a]

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[a] Survey.—Report, Feb. 18, 1828. (H. Doc. No. 482, 55th Cong., 2d sess.)

## COBSCOOK BAY, ME. (Near Fall Island).[a]

**Appropriations.**
1836, $300, act July 4, (survey).
1852, 5,000, act Aug. 30.

Total, 5,300.

**Engineers.**

CHIEF OF ENGINEERS Reports, **66**, 7, 36.

ENGINEER IN CHARGE. Col. J. D. Graham, **66**, 36.

**Project.**

For removing obstruction to navigation, **66**, 7, 36.

## COCHECO RIVER, N. H.[b]

**Appropriations.**
1829, [c]$60, act Mar. 2.
1836, 5,000, act July 4.
1837, 5,000, act Mar. 3.
1871, 10,000, **71**, 92.
1872, 10,000, **72**, 91.
1873, 10,000, **73**, 101.
1874, 10,000, **74**, 110.
1875, 25,000, **75**, 116.
1876, 14,000, **76**, 42.
1878, 6,000, **78**, 41.
1882, 28,000, **82**, 428.
1884, 28,000, **84**, 473.
1886, 10,000, **86**, 551.
1888, 9,000, **88**, 397.
1890, 25,000, **90**, 453.
1892, 15,000, **92**, 530.
1894, 15,000, **95**, 574.
1896, 15,000, **96**, 578.
1899, 20,000, **99**, 1046.

Total, 260,060

**Commerce.**

Important, **71**, 856, 859; **77**, 168; **83**, 429; **86**, 550.

Decrease in freight charges resulting from the improvement, **90**, 453, 475.

A saving of 50 cents per ton on coal alone a result of the improvement, **93**, 718.

**Contracts.**

**1871.** Morris & Cumings, rock excavation, **71**, 857.

**1872.** E. Moore, rock excavation, **73**, 1079.

**1873.** E. Moore, rock excavation, **73**, 1079.

**1874.** E. Moore, rock excavation, **75**, ii, 398.

**1875.** J. Andrews, rock excavation. Aug. R. Wright, dredging, 40 and 70 cents. **75**, ii, 398.

**1877.** Atlantic Dredging Co., dredging, 49 and 97 cents, **77**, 168.

**1883.** Hamilton & Sawyer, excavation of cut-off channel through Alleys Point, **83**, 428.

**1884.** T. Symonds, rock removal and dredging, **85**, 475, 476.

**1886.** T. Symonds, rock removal, $9.50 and $4.50 per c. y., **87**, 466, 467.

**1889.** T. Symonds, dredging, 45 cents per c. y., **89**, 542.

**1890.** C. H. Souther, dredging, 39½ cents per c. y. for soft and $1.35 for hard material, **91**, 608.

**1894.** Rogers & Fitzpatrick, ledge removal, $6.44 per c. y. ($12,880), **94**, 526.

**1895.** A. W. Bryne, ledge removal, $6.20 per c. y. in place ($12,400), **95**, 574.

**1897.** S. J. Donovan, ledge removal, $7.50 per c. y. in place ($9,750), **97**, 795.

**1899.** A. B. Martin, dredging, 90 cents per c. y. ($17,914.41), **1900**, 1148.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 31, 83; **71**, 92; **72**, 91; **73**, 100; **74**, 109; **75**, 115; **76**, 41; **77**, 36; **78**, 40; **79**, 47; **83**, 65; **84**, 72; **85**, 59; **86**, 59; **87**, 20; **88**, 20; **89**, 30, 32; **90**, 25, 26; **91**, 31; **92**, 37; **93**, 35; **94**, 34; **95**, 36; **96**, 39; **97**, 40; **98**, 50; **99**, 59; **1900**, 66.

ENGINEER IN CHARGE:

Lt. Col. G. Thom, 1870–79. Reports, **71**, 856; **72**, 938; **73**, 1078; **74**, ii, 309; **75**, ii, 397; **76**, 162; **77**, 167; **78**, 203; **79**, 260.

Col. C. E. Blunt, 1883–86. Reports, **83**, 426; **84**, 471; **85**, 474.

Maj. J. A. Smith, 1886–92. Reports, **86**, 548; **87**, 466; (Lt. Col.) **88**, 396; **89**, 542; **90**, 453, 475; **91**, 607.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 529; **93**, 717; **94**, 524.

Lt. Col. D. P. Heap, 1895. Report, **95**, 573.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 576.

Maj. R. L. Hoxie, 1897–98. Reports, **97**, 794; **98**, 835.

Maj. S. W. Roessler, 1899. Report, **99**, 1046.

Maj. W. L. Fisk, 1900–. Report, **1900**, 1147.

ASSISTANT. F. S. Burrowes. Report, **90**, 477.

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[a] Survey.—Report, Sept. 20, 1837; estimate, $26,000. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] Survey.—Report, Feb. —, 1830; estimate, $4,199.36. (H. Doc. No. 482, 55th Cong., 2d sess.)
[c] Survey.

## COCHECO RIVER, N. H.—Continued.

**Operations.**

Mention of previous operations, **71**, 858.

**1871-72.** Rock excavation in progress, **72**, 939.

**1872-73.** Rock excavation in progress, **73**, 1079.

**1873-74.** 772 c. y. rock removed and cofferdam constructed, **74**, ii, 309.

**1874-75.** 483 c. y. rock removed, **75**, ii, 398.

**1875-76.** 7,108 c. y. dredged and 1,102 c. y. rock removed, **76**, 41; **77**, 168.

**1876-77.** 600 c. y. rock removed, **77**, 168.

**1877-78.** 12,371 c. y. dredged and 300 c. y. rock removed, **78**, 40, 204.

**1878-79.** 3,000 c. y. dredged, **79**, 262.

**1882-83.** 12,260 c. y. removed from cut-off through Alleys Point, **83**, 428.

**1883-84.** 10,600 c. y. gravel and 135 tons bowlders removed from cut-off at Alleys Point, completing the proposed work thereat, **84**, 471.

**1884-85.** 3,408 c. y. rock and hardpan removed from channel above Clements's wharf, **85**, 475.

**1885-86.** 829 c. y. rock removed, **86**, 549.

**1887-88.** 738 c. y. solid rock and 530 c. y. bowlders removed, **88**, 396.

**1888-89.** 672 c. y. clay dredged and 4,780 c. y. clay removed, **89**, 542.

**1889-90.** Project completed, **90**, 453.

**1891-92.** Channel dredged to 7 f. depth at m. l. t. at Dover and at Clements's wharf, **92**, 530.

**1893-95.** About 2,100 c. y. rock removed, **94**, 526; **95**, 574.

**1895-96.** About 1,800 c. y. rock removed, **96**, 578.

**1896-97.** About 600 c. y. rock removed, **97**, 794.

**1897-98.** 535 c. y. rock removed, **98**, 836.

**1898-99.** 356 c. y. rock removed, **99**, 1046.

**1899-1900.** 19,904 c. y. dredged, **1900**, 1148.

**Physical characteristics.**

Location of improvement, **71**, 858.

Presence of rocks and shoals, **71**, 858.

Tides, **71**, 859.

Description of, **90**, 475.

**Projects.**

In 1836-37 $10,000 was appropriated for the improvement of the Cocheco Branch. Project of 1870 proposed the formation, by rock removal and dredging, of a channel 40 f. wide and 4 f. deep at m. l. w. through the Lower Narrows and up to the packet landing in Dover, **71**, 857; **72**, 939; **76**, 164. This work was accomplished in 1879 under aggregate appropriations of $95,000, **79**, 261; **83**, 427; **86**, 549.

In 1882 the project was amended to provide for a cut-off channel through Alleys Point and widening to 60 f. and deepening to 5 f. through Trickeys and Clements Point shoals; estimate, $28,000, **83**, 427.

This work having been accomplished in 1883, Col. Blunt proposed, 1884-85, to widen to 50 f. and deepen to 5 f. m. l. w. all parts of the channel with less dimensions, from Clements Point to the packet landing; estimate, $47,000, **84**, 471; **85**, 475; **87**, 466. Project completed in 1889, **89**, 542.

After examination and survey in 1889, Lt. Col. Smith proposed to obtain a channel depth of 7 f., increased to 7½ when passing over rock, with a minimum width of 50 f. in rock and 60 f. where the material less expensive to remove; estimate, $175,000, **90**, 477; **91**, 607; **92**, 530.

**Surveys.**

Under direction of Lt. Col. Thom, 1870-71. Reports, **71**, 858; **72**, 939.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Smith, **90**, 475.

MAPS. Of Cocheco River, vicinity of Dover, **85**, 474.

## COCKPIT POINT, VA. (Ice harbor.)

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 153.

ENGINEER IN CHARGE. S. T. Albert, U. S. agent. Report, **85**, 999.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of Mr. Abert (report unfavorable), **85**, 999.

## COCODRIE BAYOU, LA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 229.

ENGINEER IN CHARGE. Capt. W. L. Fisk. Report, **91**, 1849.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Capt. Fisk (report unfavorable), **91**, 1849.

## COENTIES REEF. (See *East River, N. Y.*)

## CŒUR D'ALENE LAKE AND RIVER, AND ST. JOSEPHS RIVER, IDAHO.

**Engineers.**

Chief of Engineers. Report, **85**, 372.

Engineer in Charge. Maj. W. A. Jones. Report, **85**, 2442.

**Plans.**

In 1884 Maj. Jones recommended spending $3,000, **85**, 2443. Improvement not recommended by the Chief of Engineers, **85**, 372.

**Survey.** (See *Plans.*)

Examination ordered by act of July 5, 1884, made under direction of Maj. Jones, **85**, 2442.

## COHANSEY CREEK, N. J.

**Appropriations.**

1873, $10,000, **73**, 82, 870; **75**, ii, 195; **76**, 277; **77**, 269.
1878, 5,000, **78**, 62, 442.
1879, 4,500, **79**, 69, 415.
1880, 4,500, **80**, 592.
1881, 7,000, **81**, 790.
1882, 5,000, **82**, 773.

Total, 36,000

**Contracts.**

**1873.** American Dredging Co., dredging, **73**, 871.

**1878.** M. F. Brainard, dredging, 24½ cents per c. y., annulled, **79**, 416.

**1880.** J. V. Patten, dredging, 25 cents per c. y., **80**, 592.

**1881.** J. V. Patten, dredging, 32 cents per c. y., **81**, 791.

**1882.** F. C. Somers, dredging, 57 cents per c. y., **83**, 629.

**Engineers.**

Chief of Engineers. Reports, **72**, 78; **73**, 81, 82, 83; **74**, 93; **75**, 99; **76**, 61; **77**, 56; **78**, 62; **79**, 68; **80**, 95; **81**, 124, 129; **82**, 122, 126; **83**, 123; **84**, 132; **85**, 125; **86**, 122; **87**, 84; **88**, 84.

Engineers in Charge.

Lt. Col. J. D. Kurtz, 1872–77. Reports, **72**, 791; **73**, 870, 889; **74**, ii, 144; **75**, ii, 195; **76**, 277; **77**, 269.

Capt. Wm. Ludlow, 1877, in temporary charge, **78**, 431; **79**, 403.

Col. J. N. Macomb, 1878–81. Reports, **78**, 442; **79**, 414; **80**, 590; **81**, 789.

Capt. W. Ludlow, 1882–83. Report, **82**, 773.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 629.

Maj. W. H. Heuer, 1884–85. Report, **84**, 831.

Lt. Col. H. M. Robert, 1885–88. Reports, **85**, 853; **86**, 847; **87**, 812; **88**, 714.

Assistants.

J. J. Lee. Report, **73**, 889; **78**, 442; **83**, 629.

Capt. W. Ludlow, **78**, 431; **79**, 403.

**Estimates.** (See *Projects.*)

By J. J. Lee, 3-foot channel, $22,000, **73**, 890, 891; **75**, ii, 195; **76**, 277; **77**, 269.

**Obstructions.**

Delay of city authorities in lowering gas and water pipes at Broad Street Bridge to permit continuation of dredging, **81**, 789.

**Operations.**

**1873–74.** 24,139 c. y. sand and mud removed; a channel 75 f. to 80 f. in width and 3 f. in depth at low water opened along the wharves of the city of Bridgeton and for a distance of ¼ mile below Broad Street Bridge to deeper water, **75**, 93, ii, 144, 145.

**1879–80.** 28,605 c. y. dredged, **80**, 590.

**1880–81.** 10,788 c. y. dredged, **81**, 789.

**Physical characteristics.**

Described, **73**, 890, 891; **79**, 414, 415.

Obstacles to navigation, **81**, 672.

**Projects.** (See *Estimates.*)

Submitted by J. J. Lee, 1872, adopted by Lt. Col. J. D. Kurtz, for channel 130 f. wide and 4 f. deep from the deep water at the lower steamboat landing to Broad Street Bridge and 3 f. deep to the nail-works bridge, 67,988 c. y., $30,000, **73**, 889, 891. Modified by Col. Macomb to make the channel 80 f. wide and from 5 f. to 7 f. deep; additional cost, $10,500, **79**, 69, 415; **80**, 591.

**Surveys.**

Under direction of Col. Kurtz, by J. J. Lee, 1872. Report, **73**, 889.

Ordered by act of Mar. 3, 1881; made, 1881, under the direction of Col. Macomb, **81**, 129.

Maps. Chart of Cohasney Creek at Bridgeton, **79**, 414.

## COHASSET HARBOR, MASS.

**Commerce.**
Estimated value, $25,000 annually, **1900**, 1221.

**Engineers.**
Chief of Engineers. Reports, **89**, 43; **99**, 81; **1900**, 93.
Engineers in Charge:
Lt. Col. S. M. Mansfield, 1889. Report, **89**, 595.
Col. C. R. Suter, 1900–. Report, **1900**, 1221, 1222.
Assistant. T. T. H. Harwood. Report, **1900**, 1223.

**Physical characteristics.**
Description of, **1900**, 1221.

**Project.**
Col. Suter, 1899, estimated it would cost $21,670 to improve the harbor, **1900**, 1223.

**Surveys.**
Examination ordered by act of Aug. 11, 1888. Made, 1888, under direction of Lt. Col. Mansfield (report unfavorable), **89**, 595.
Examination and survey ordered by act of Mar. 3, 1899, made under direction of Col. Suter, 1899 (report favorable), **1900**, 1221, 1222. (See *Projects.*)

## COLBERT SHOALS. (See *Tennessee River.*)

## COLD SPRINGS BAY, N. Y. (See *Lloyds Harbor, N. Y.*)

## COLD SPRING HARBOR, N. Y.

**Commerce.**
Description of; limited, **95**, 875.

**Engineers.**
Chief of Engineers. Report, **95**, 94.
Engineer in Charge. Lt. Col. H. M. Robert, 1895. Report, **95**, 874.
Assistant. Lt. W. E. Craighill. Report, **95**, 875.

**Physical characteristics.**
Description of. Situated at the head of Oyster Bay, Long Island, and about 35 miles from New York. A biological laboratory of the Brooklyn Institute and a building of the New York Fish Commission are shut off from communication with the outer harbor, where most of the shipping of the district is done, by a shoal inner harbor. **95**, 875.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made under direction of Lt. Col. Robert, 1894 (report unfavorable), **95**, 874.

## COLD SPRING INLET, N. J.

**Commerce.**
Unimportant, **95**, 1099.

**Engineers.**
Chief of Engineers. Report, **95**, 133.
Engineer in Charge. Maj. C. W. Raymond, 1894–95. Report, **95**, 1098.

**Physical characteristics.**
Description of, **95**, 1098.

**Survey.**
Examination ordered by act of Aug. 17, 1894; made by Maj. Raymond, 1894 (see *Commerce*), **95**, 1098.

## COLDWATER RIVER, MISS. (See *Tullahatchee River.*)

**Appropriations.**
1879, $7,000, **79**, 116.
1880, 4,000, **80**, 1321.

Total, 11,000

**Commerce.**
Fertility of country tributary to river, **79**, 985.
Description of; unimportant, **93**, 2100; **97**, 1943.

**Engineers.**
Chief of Engineers:
Reports, **78**, 88; **79**, 116, 118; **80**, 155; **81**, 209; **82**, 206; **83**, 215; **84**, 225; **85**, 240; **93**, 272; **97**, 310.
Engineers in Charge:
Capt. W. H. H. Benyaurd, 1878–83, **78**, 88; **79**, 112, 117. Reports, **79**, 970, 984; (Maj.)**80**, 1321; **81**, 1413; **82**, 1551.
Maj. A. M. Miller, 1883–85. Reports, **83**, 1149; **84**, 1336.
Capt. E. Bergland, 1885. Report, **85**, 1518.
Capt. J. H. Willard, 1893–97. Reports, **93**, 2099; **97**, 1943.
Assistants:
J. M. Searles, **79**, 982.
J. Barry. Report, **80**, 1321.
J. H. Burney. Report, **80**, 1322.

**Operations.**
**1879–80.** 2,777 trees cut and girdled, **80**, 1321.
**1880–81.** 3,553 logs, snags, and stumps removed and trees cut down, **81**, 1413.

## COLDWATER RIVER, MISS.—Continued.

**Physical characteristics.**
Description of, **79**, 984, 985; **93**, 2099; **97**, 1944.

**Projects.**
By Capt. Benyaurd, 1879, removing obstructions with hired labor, U. S. flatboat; estimate, $25,000, **79**, 116, 970, 985.

**Surveys.**
Examination ordered and in progress, **78**, 88.

Examination completed by J. M. Searles, **79**, 118, 982.

Examination of Coldwater and Tallahatchee rivers, made, 1880, under direction of Maj. Benyaurd, **80**, 1322.

Examination ordered by act of July 13, 1892, made, 1893, by Capt. Willard (report unfavorable), **93**, 2099.

Examination ordered by act of June 3, 1896, made, 1896, by Maj. Willard (report unfavorable), **97**, 1743.

## COLONIAL BEACH, WESTMORELAND COUNTY, VA.

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 153.

ENGINEER IN CHARGE. S. T. Abert, U. S. agent. Report, **85**, 1001, 1002, 1004.

**Physical characteristics.**
Description of locality, **85**, 1001, 1005.

**Plans.**
By S. T. Abert, 1885, dredged channel 300 f. wide and 16 f. deep and a turning basin 400 f. square. Estimate, $20,800. **85**, 1003, 1005. Not approved by the Chief of Engineers, **85**, 153.

**Survey.**
Ordered by act of July 5, 1884, made under the direction of S. T. Abert (see *Plans*), **85**, 1001, 1002.

## COLORADO. (See *Wyoming.*)

## COLORADO RIVER, ARIZ., CAL., AND NEV.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1884, | $25,000, | **85**, 2367. |
| 1892, | 10,000, | **93**, 3235. |
| Total, | 35,000 | |

**Commerce.**
Unimportant, **69**, 68; **79**, 1773, 1774, 1778, 1780; **96**, 3187; **97**, 3340.

**Contracts.**
**1893.** Baker & McKeown, levee, 33,807 c. y. at 12½ cents per c. y., **94**, 2522.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **68**, 76, 1195; **69**, 68; **76**, 120; **78**, 137; **79**, 180; **85**, 363; **86**, 356; **87**, 324; **89**, 348; **91**, 393; **93**, 424; **94**, 397; **95**, 435; **96**, 388; **97**, 487.

ENGINEERS IN CHARGE:
Lt. J. C. Ives, 1857–58. **68**, 1195.
Maj. R. S. Williamson, **68**, 76. Report, **68**, 1190.
Capt. S. M. Mansfield, **68**, 76. Report, **68**, 1188.
Lt. G. M. Wheeler, **76**, 120.
Lt. Col. C. S. Stewart, **78**, 137; **79**, 180. Report, **79**, 1773.
Capt. A. H. Payson, 1884–87. Reports, **85**, 2365; **86**, 1929; **87**, 2449.
Lt. Col. W. H. H. Benyaurd, 1888–95. Reports, **89**, 2481; **91**, 2974; **93**, 3234; **94**, 2521; **95**, 3278.
Lt. C. L. Potter, 1896. Report, **96**, 3186.
Maj. C. E. L. B. Davis, 1897. Report, **97**, 3339.

ASSISTANTS:
Lt. E. Bergland, **76**, 120. Report, **76**, iii, 329.
Lt. A. H. Payson. Report, **79**, 1774.
Lt. S. W. Roessler. Report, **85**, 2367.

**Estimates.** (See *Plans and Projects.*)
By Lt. Payson, removal of obstructions and rectification of channels, $97,269; not recommended by Lt. Col. Stewart, **79**, 1774, 1780.

**Legislation.**
To aid Capt. Trueworthy in perfecting navigation of Colorado River below Callville, **68**, 1195.

**Operations.**
**1884–85.** 1,074 tons stone removed from river bed; 614 l. f. cobble dam built, **85**, 2367.
**1885–86.** 2,688 l. f. cobble dam built; top of Explorer's Rock blasted off; 1,240 tons rock removed, **86**, 1931.
**1886–87.** Property and supplies sold at auction and proceeds turned into Treasury, **87**, 2449.
**1893–94.** 53,807 c. y. material placed in levee, **94**, 2521; project considered completed, **95**, 3278.

**Physical characteristics.**
Description, **68**, 1188–1190, 1194, 1195; **79**, 1773, 1775, 1776; **91**, 2975; **93**, 3235; **96**, 3186; **97**, 3339.

[a] Colorado River of the West.

## COLORADO RIVER, ARIZ., CAL., AND NEV.—Continued.

River navigable to Callville by light craft, **68**, 1188; **79**, 1779.

Description by C. C. Parry, geologist, **68**, 1191.

Descriptive narrative of river, **68**, 1192, 1193.

Topography, **76**, iii, 343–345.

Table of distances, **79**, 1776.

Slope and discharge of river, **79**, 1776, 1777.

List of obstructions, **79**, 1782.

Yuma, situated at the junction of the Gila and Colorado rivers, subject to floods of those rivers, **93**, 3234.

For a considerable part of the year the river bed of the Gila at Yuma is dry, **93**, 3235.

**Plans.** (See *Estimates and Projects.*)

By Lt. Bergland, 1876, diverting the Colorado River for purposes of irrigation, **76**, iii, 337.

By Lt. Payson, 1879, removal of obstructions, protection of banks, and contraction of channel; estimate, $97,269; not recommended by Lt. Col. Stewart, **79**, 1780.

By Lt. Col. Benyaurd, 1893, levee 3,200 f. long with an average height of 10 f. along the margin of the slough near the eastern boundary of Yuma, starting from Penitentiary Hill and connecting with an old embankment of the Southern Pacific R. R. near the southern limits of the town, to confine the waters of the two rivers to their channels, **93**, 3235.

**Private work.**

To protect the village of Yuma from floods the authorities several years previous to 1892 built small levees along the banks of the two rivers, **93**, 3234.

**Projects.** (See *Estimates* and *Plans.*

By Capt. Payson, 1879, removing obstructions, protecting banks, and constructing channel; estimate, $97,269, **79**, 1780.

In 1886 it was reported that any noteworthy improvement would be at an enormous cost not required by commerce, **86**, 1932; **87**, 2449.

**Surveys.**

By Lt. Ives, exploration, 1857, **68**, 1188, 1191, 1195.

Examination by Lt. Bergland, **76**, 120, iii, 329.

Survey, under direction of Lt. Col. Stewart, to El Dorado Canyon, **79**, 180, 1773, 1774.

Examination between Camp Mojave and El Dorado Canyon, Ariz., ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Benyaurd (report unfavorable), **89**, 2481.

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Benyaurd (report unfavorable), **91**, 2974.

Survey made, 1892, by Lt. Col. Benyaurd, **93**, 3234.

Examination of the river, mouth of the Virgin River to Yuma, ordered by act of Aug. 17, 1894, made, 1895, by Lt. Potter (report unfavorable, cost too great), **96**, 3186.

Examination ordered by act of June 3, 1896 (report unfavorable); submitted in that year by Maj. Davis, **97**, 3339.

MAPS:

Topographical sketches, **76**, iii, 332, 339.

Sketch and section, **76**, iii, 341, 343, 345.

Profiles, **76**, iii, 336; **85**, 2368.

## COLORADO RIVER, TEX.[a]

**Appropriation.**

1852, $20,000, act Aug. 30.

**Commerce.**

Too small to be benefited by river improvement, **95**, 1823; **1900**, 2459.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7; **91**, 235, **95**, 266, **99**, 346, **1900**, 397.

ENGINEERS IN CHARGE:

Maj. C. J. Allen. Report, **91**, 1939.

Maj. A. M. Miller, 1895. Report, **95**, 1821.

Capt. C. S. Riché, 1900–. Report, **1900**, 2458, 2461.

ASSISTANTS:

S. M. Wilcox. Report, **95**, 1824.

E. M. Hartrick. Report, **1900**, 2460.

**Physical characteristics.**

Description of, between mouth and Wharton; raft, sand bars, sharp bends, and snags, **95**, 1822.

Great raft in river, **91**, 1939, **1900**, 2460. "Raft" situated about 12 miles from the mouth of the river; really a succession of rafts covering 15 to 20 miles of the river, **1900**, 2462.

**Surveys.**

Examination for removal of raft at the mouth ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Allen (report unfavorable), **91**, 1939.

Examination of the river from its mouth to Wharton, Tex., ordered by act of Aug. 17, 1894, made, in that year, under

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[a] Examination—Report (favorable) Apr. 27, 1853. (H. Doc. No. 482, 55th Cong., 2d sess.)

## COLORADO RIVER, TEX.—Continued.

the direction of Maj. Miller (report unfavorable), **95**, 1821.

Examination of the river from its mouth to great raft, ordered by act of March 3, 1899, made, 1899, under direction of Capt. Riché (report unfavorable), **1900**, 2459.

Examination for a 10 f. canal, 100 f. wide, around the raft in Colorado River, in Matagorda County, Tex., ordered by act of Mar. 3, 1899, made, 1899, by Capt. Riché (report unfavorable), **1900**, 2461.

## COLUMBIA FALLS. (See *Pleasant River, Me.*)

## COLUMBIA RIVER. (See *Pend D'Oreille, Idaho and Wash.; Shoalwater Bay, etc.; Snake River, Wash.; Willamette and Columbia Rivers.*)

Parts.
A.—Upper river and Snake River.
B.—Cascades.
C.—Columbia River, Oreg. and Wash.
D.—Gauging.
E.—Upper river, Wash.
F.—Clark's Fork.
G.—Threemile Rapids and boat railway from Dalles to Celilo Falls.
H.—Vancouver, Wash., to mouth of Willamette.
I.—Rock Island Rapids to Foster Creek, Wash.
J.—Below Tongue Point and in front of Astoria, Oreg.

### Part A.—Columbia (Upper) and Snake rivers, Oreg. and Wash.

**Appropriations.**

| | | |
|---|---|---|
| 1872, | [a] $50,000, | **73**, 107. |
| 1874, | [a] 20,000, | **74**, 117. |
| 1875, [b] | [a] 35,000, | act of Mar. 3 **76**, ii, 637. |
| 1876, | [c] 15,000, | **76**, 116. |
| 1878, | [c] 20,000, | **78**, 137. |
| 1879, | [c] 20,000, | **79**, 181. |
| 1880, | 15,000, | **80**, 2292. |
| 1881, | 15,000, | **81**, 2562. |
| 1882, | 6,000, | **82**, 2663. |
| 1884, | 20,000, | **84**, 2231. |
| 1886, | 10,000, | **86**, 1950. |
| 1888, | 10,000, | **88**, 2189. |
| 1890, | 20,000, | **90**, 2983. |
| 1892, | 15,000, | **92**, 2715. |
| 1894, | 5,000, | **95**, 3393. |
| 1896, | 5,000, | **96**, 3384. |
| 1899, | 7,500, | **99**, 3219. |
| Total, | 288,500 | |

**Commerce.**

Commercial importance of the Upper Columbia, **67**, 510, 511; **75**, ii, 789.

Commerce large and increasing, **68**, 875; **72**, 998; **79**, 1840.

The Cascades a serious obstruction to navigation, **75**, ii, 772.

Commercial importance of the Snake River, **78**, 1332.

Navigation on the Upper Columbia, **85**, 2445, 2448.

Important, **93**, 3377; **95**, 3392.

Importance of navigation between Riparia and Lewiston continually increasing **97**, 3457.

In 1898 there was no navigation of importance to be benefited by an improvement of Snake River from its mouth to Riparia, and could be none until the Dalles of the Columbia River were made navigable, **98**, 3017.

**Contracts.**

UPPER COLUMBIA RIVER:

**1872.** J. B. Montgomery, removal of rock, **73**, 107, 1121, 1122. Contract extended, **73**, 1121.

**1875.** Grant & Stone, removal of rock, **76**, ii, 637, 663. Contract extended, **77**, 1041.

**1876.** J. B. Montgomery, removal of rock, **77**, 1041. Contract extended, **77**, 1043. Grant & Stone, removal of rock,, **77**, 1042. Contract extended, to cover additional amount of rock excavation, **76**, ii, 664.

SNAKE RIVER:

**1876.** J. B. Montgomery, removal of rock, **77**, 1046.

**1877.** Proposals were invited by letter, without advertising, as per letter of authority from the Chief of Engineers, **77**, 1041, 1046.

**1878.** G. J. Ainsworth, removal of rock, **79**, 1789, 1842.

COLUMBIA AND SNAKE RIVERS:

**1880.** G. J. Ainsworth, rock removal, $18 per c. y., **80**, 2293. J. B. Montgomery, rock removal, $17 and $25 per c. y., **81**, 2563.

**1883.** F. T. Dodge, rock removal, $12; gravel, $2 per c. y., **83**, 2042.

**1884.** J. Kelley & Co., wing-dam construction, **85**, 2438. Holmes & Spencer, rock removal, and J. R. Smith, rock removal, **85**, 2438.

**1900.** Informal contract for rubblestone for dike repairs, **1900**, 4320.

**Engineers.**

CHIEF OF ENGINEERS:

Letter from the Chief of Engineers to T. H. Canfield, director of the Northern Pacific R. R. Co., **73**, 1122.

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[a] Upper Columbia.
[b] Appropriation of 1875 called $20,000, **75**, 125, ii, 787.
[c] Upper Columbia and Snake.

**COLUMBIA RIVER**—Continued.

**Part A.—Columbia (Upper) and Snake rivers, Oreg., etc.**—Cont'd.

Reports, **66**, iii, 27; **68**, 73; **73**, 107; **74**, 117; **75**, 125; **76**, 115; **77**, 123; **78**, 138; **79**, 181, 183; **80**, 238; **81**, 236; **82**, 320; **83**, 333; **84**, 337; **85**, 370; **86**; 359, 360; **87**, 332; **88**, 305; **89**, 363; **90**, 322; **91**, 405; **92**, 380; **93**, 438; **94**, 408; **95**, 448; **96**, 414; **97**, 518; **98**, 493, 503; **99**, 580; **1900**, 652.

ENGINEERS IN CHARGE:
Maj. R. S. Williamson, 1866–71. Reports, **66**, iv, 327; **68**, 874.
Maj. H. M. Robert, 1871–73. Reports, **72**, 996; **73**, 1121; **74**, ii, 364.
Maj. N. Michler, 1873–75. Reports, **74**, ii, 358; **75**, ii, 772; **76**, ii, 637.
Maj. J. M. Wilson, 1875–78. Reports, **76**, ii, 662; **77**, 1036; **78**, 1330; **79**, 1789.
Maj. G. L. Gillespie, 1878–81. Reports, **79**, 1839; **80**, 2289; **81**, 2558.
Capt. C. F. Powell, 1881–84. Reports, **82**, 2660; **83**, 2040; **84**, 2229.
Maj. W. A. Jones, 1884–90. Reports, **85**, 2437; 2445, 2452; **86**, 1949, 1953, 1970; **87**, 2520, **88**, 2188; **89**, 2584.
Capt. T. W. Symons, 1890–95. Reports, **90**, 2981; **91**, 3210; **92**, 2709, 2721; **93**, 3375; **94**, 2590; **95**, 3391.
Capt. W. L. Fisk, 1896–98. Reports, **96**, 3382; **97**, 3456; (Maj.), **98**, 2977, 3013.
Capt. W. W. Harts, 1899–. Reports, **99**, 3219; **1900**, 4319.

ASSISTANTS:
Lt. W. H. Heuer. Reports, **68**, 877; **69**, 478.
R. B. Randall, **75**, ii, 787; drowned, **75**, ii, 787.
R. A. Habersham. Report, **75**, ii, 790.
R. M. Tabor, **77**, 1043; **79**, 1840.
P. C. Eastwick. Report, **84**, 2232.
Lt. T. Symons. Report, **85**, 2445.
Lt. W. Young. Report, **86**, 1951.
E. T. Voigt. Report, **86**, 1955.
W. H. Wood. Report, **92**, 2712.
W. Cuthbert. Report, **92**, 2723.
J. M. Clapp. Report, **97**, 3458.

**Estimates.** (See *Plans* and *Projects*.)
By Lt. Heuer, removing obstructions in the Upper Columbia River, $100,000, **66**, iv, 330; $166,686, **69**, 476, 477. For dredging, annually, $6,000, **69**, 479.
By Maj. Williamson, removing isolated rocks in the Upper Columbia, Dalles to mouth of the Snake River, $132, 328, **68**, 74, 874.
By Maj. Robert, removing 1,200 c. y. rock, $39,294.44, **72**, 996.
By Maj. Wilson, improvement of the Upper Columbia and Snake rivers, $132,000, **77**, 1045; **78**, 1332.

**Operations.**
UPPER COLUMBIA RIVER.
**1872–73.** 1,213 c. y. rock removed; work done on John Day Rock and Umatilla Rapids, **73**, 107, 1121.
**1873–74.** 465 c. y. rock removed, **74**, 125.
**1874–75.** 350 c. y. rock removed; nine dangerous rocks removed, **75**, 125, ii, 774, 776; **76**, ii, 638.
**1875–76.** 486 c. y. rock removed, **76**, 115, ii, 663, 664.
**1876–77.** 268 c. y. rock removed, **77**, 123, 1044.
**1877–78.** 147 c. y. rock removed, **78**, 1331.

SNAKE RIVER.
**1876–77.** 477 c. y. rock removed from river at Pine Tree Rapid, **77**, 123, 1044.
**1878–79.** 1,093 c. y. rock removed from Pine Tree, Five-Mile, and Fish Hook rapids, **79**, 1789, 1842.

COLUMBIA AND SNAKE RIVERS.
**1879–80.** Rock removal, Monumental, Homly, and Umatilla rapids, **80**, 2290, 2297.
**1880–81.** Rock removal, Monumental and Texas rapids, **81**, 2558, 2560.
**1881–82.** Rock removal, Texas, Palouse, and False Palouse rapids, **82**, 2660.
**1883–84.** Rock removal at Five-Mile Rapids, **84**, 2230.
**1884–85.** Rock removal at Whites Ferry, Jim Fords Island, and Fish Hook rapids, **85**, 2437.
**1885–86.** 645 c. y. rock and gravel removed from rapids, **86**, 1949.
**1886–87.** Construction of drilling scow, and rock removal by hired labor at Texas and Little Goose rapids; construction of sheer crib on Log Cabin rapids; survey of rapids, **87**, 2521, 2522.
**1888–89.** 2,385 c. y. rock removed, **89**, 2584.
**1890–91.** Construction of drill scow and preparation of plant, **91**, 3211.
**1891–92.** 293 c. y. bed rock and bowlders removed from channel between Riparia and Lewiston, **92**, 2710.
**1892–93.** Dikes in course of construction at Wild Goose and Log Cabin rapids, **93**, 3377.
**1893–94.** Work on Wild Goose dike continued, **94**, 2592.
**1896–97.** Dikes at Wild Goose and Log Cabin rapids completed and repaired, **97**, 3457.
**1897–98.** 666 f. dike constructed at Wild Goose Rapids, **98**, 2977.
**1899–1900.** Government plant repaired; about 1,000 c. y. rubblestone quarried for dike repairs; dike repairs in progress, **1900**, 4220.

**Physical characteristics.**
High and low water, **66**, iv, 330; **75**, ii, 791; **76**, ii, 651.

## COLUMBIA RIVER—Continued.

### Part A.—Columbia (Upper) and Snake Rivers, Oreg., etc.—Cont'd.

Record of flood levels, **75**, ii, 791.

Cascades a series of rapids, with a fall of 37.3 f. in 5¾ miles, **75**, ii, 772.

Action of ice at Hell Gate, **75**, ii, 780, 788.

Rapids on the Upper Columbia, **76**, ii, 662.

Character of bed of river at Homly Rapids, **76**, ii, 663.

Columbia River above The Dalles a series of falls and rapids, **75**, ii, 772; **77**, 1037.

Snake River a succession of rapids, **77**, 1039.

Description of, **80**, 2393; **84**, 2234.

Elevation of water surface, Upper Columbia, **86**, 1958.

Current observations, Upper Columbia, **86**, 1959; **87**, 2521.

Principal rapids, Celilo to Lewiston, with fall and slope, **91**, 3214.

Description of Snake River, mouth to Riparia, **98**, 3014.

Prior to improvement at Goose Island steamers ascending the stream had to be warped up, but beginning in 1898 this method of navigating the stream was dispensed with on account of the better conditions, **98**, 2978.

Tabulated list of shoals, rapids, and prominent bends, **98**, 3018; description of, in detail, **98**, 3019.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Williamson, removal of rock from the Upper Columbia, so the largest boats could navigate at all times, **68**, 874.

By Maj. Michler, canal and locks around Celilo Falls, at the head of The Dalles, 4,500 f. long, with a rise of 36 f., **75**, ii, 772.

By Maj. Jones, 1885, Priest Rapids, Columbia River above Snake, removal of rock; estimate, $153,240, **86**, 1965.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Robert, Upper Columbia, removal of obstructions (isolated rock) at John Day Rock, Devils Bend, and Umatilla rapids; estimate, $39,294, **72**, 996.

By Maj. Robert, improvement, Homly Rapids, **73**, 1121.

By Maj. Wilson, removal of 1,500 c. y. rock from river channel, **77**, 1036, 1041, 1045.

By Maj. Wilson, Snake River, mouth to Lewiston, removal of 2,900 c. y. rock, **77**, 1041, 1045.

Previous to the adoption of the project of 1877 efforts were directed to the removal of rocks at rapids on the Upper Columbia below the mouth of Snake River, **77**, 1044; **80**, 2294. The project of 1877 proposed the removal of rock at rapids so as to give channel depths of 5½ f. on the Columbia and 4½ f. on the Snake River, between Celilo on the former and Lewiston on the latter, 266 miles; estimate, $132,000, **77**, 1045; **82**, 2040; **86**, 359; **87**, 2520.

By Capt. Symons, 1892, dike construction at Wild Goose Island, Diamond Crossing, and Log Cabin Rapids, with removal of bowlders; estimate, $29,226, **92**, 2715.

By the terms of the act of 1892, the upper limit of work was extended from Lewiston, Idaho, to Asotin, Wash., 7 miles, **93**, 3376.

In 1898, Capt. Taylor estimated it would cost $165,000 to further improve Snake River, and that after the completion of the improvement $3,000 would be required annually for maintenance, **98**, 3017, 3018.

**Surveys.**

Under direction of Maj. Williamson, 1867–68, **68**, 75. Report, **68**, 874.

Under direction of Maj. Williamson, by Lt. Heuer. Report, **68**, 478.

Of Homly Rapids, under direction of Maj. Michler, 1875, **76**, ii, 637.

Of channel of the Upper Columbia, under direction of Maj. Wilson, **76**, ii, 663.

Of Upper Umatilla Rapid, under direction of Maj. Wilson, **77**, 138; **78**, 1331.

Of the Dalles of the Upper Columbia, ordered by act of Mar. 3, 1879, assigned to Maj. Gillespie, **79**, 183.

Examination of the Snake River by Maj. Michler, **76**, ii, 638. Survey of, under direction of Maj. Wilson, **77**, 1037.

Of Snake River below Lewiston, **84**, 2230, 2232.

Of Snake River above Lewiston, **82**, 2716.

Of Columbia River above mouth of Snake, **85**, 2445; **86**, 1953.

Survey of the Columbia River from the international boundary line to the head of Rock Island Rapids, made, 1892, under direction of Capt. Symons, **92**, 2721.

Survey of Snake River, mouth to Riparia, ordered by act of June 3, 1896, made, 1898, by Capt. Taylor (see *Projects*), **98**, 3013.

MAPS:

Pine Tree Rapids, **77**, 1003.

Pine Tree Rapids, Five-mile Rapids, and Fish Hook Rapids, on the Snake River, showing the positions of rocks removed, **79**, 1842.

- Monumental Rapids, **80**, 2296.
- Palouse Rapids, **81**, 2562; **82**, 2662.
- Taxas Rapids, **81**, 2562.
- False Palouse Rapids, **82**, 2662.
- 1st, 2d, 3d, 4th, 5th, 6th, and 7th rapids.
- Cabinet Rapids, **86**, 1966.
- Yakima Region, **86**, 1966.

## COLUMBIA RIVER—Continued.

### Part B.—Columbia River, Oreg. (canal around the Cascades).

#### Appropriations.

| | | |
|---|---|---|
| 1876, | $90,000, | **77**, 123, 1046, 1049. |
| 1878, | 150,000, | **78**, 138, 1337, 1338. |
| 1879, | 100,000, | **79**, 182, 1849. |
| 1880, | 100,000, | **80**, 2301. |
| 1881, | 100,000, | **81**, 2567. |
| 1882, | 265,000, | **82**, 2667. |
| 1884, | 150,000, | **84**, 2448. |
| 1886, | 187,500, | **86**, 1945. |
| 1888, | 300,000, | **88**, 2164. |
| 1890, | 435,000, | **90**, 3054. |
| 1892, | 326,250, | **92**, 2822. |
| 1893, | 1,239,653, | **93**, 3508. |
| 1896, | 229,597, | **96**, 3269. |
| 1899, | 75,000, | **99**, 3224. |
| Total, | 3,748,000 | |

#### Commerce.

Railway portage at the Cascades, **76**, ii, 667.

Benefit of the improvement to commerce, **77**, 1049; **78**, 1337.

Uncertainty of the benefits of the improvement, **80**, 2301.

Advantages of the improvement, **81**, 2566; **82**, 2668; **83**, 2044.

Draft of vessels passing the Cascades, **80**, 2312.

Character of present navigation, **81**, 2577; **82**, 2673.

Dimensions of vessels on river, **81**, 2580.

Cost of transportation, **86**, 1492; 1494.

In 1893, 5,553 passengers and 7,800 tons freight were transported between the Dalles and the Cascades, **93**, 3508.

#### Contracts.

**1878.** Ball & Platt, materials and labor, **79**, 1790.

**1880.** Ball & Platt, canal construction, **80**, 2302. Contract abrogated, **80**, 2299.

**1882.** Chalmers & Holmes, removal of submerged rock, $25, and exposed rock, $3 per c. y., **82**, 2668. Failure of contract system, **83**, 2043.

**1886.** Portland Construction Co., wharf at canal, **87**, 2480.

**1889.** F. G. Canel, granite dimension stone, $1.35 per c. y., **89**, 2544.

**1892.** J. G. & I. N. Day, canal improvement and lock construction, earth and rock excavation; furnishing, cutting, and laying stone and masonry; grading, gates, machinery, etc.; aggregate amount of bid, $1,521,265, **93**, 3511.

**1899.** H. W. Taylor, rock and earth excavation, stone, pavements, wire fencing, $51,279, **1900**, 4329.

#### Engineers.

CHIEF OF ENGINEERS. Reports, **75**, 125; **77**, 123; **78**, 138; **79**, 181; **80**, 239; **81**, 327, 2570; **82**, 321; **83**, 334; **84**, 337; **85**, 370; **86**, 358; **87**, 328; **88**, 301; **89**, 359, 2557; **90**, 326; **91**, 414; **92**, 388; **93**, 450; **94**, 415; **95**, 463; **96**, 403; **97**, 504; **98**, 496; **99**, 3222; **1900**, 4324.

BOARDS OF ENGINEERS:

Convened in Aug., 1877, to report on project of Maj. Wilson for a canal around the Cascades of the Upper Columbia. Board recommended further examinations and surveys. **78**, 1333. Reconvened at San Francisco, Cal., Sept. 22, 1877, and recommended that the canal be on the left bank, or Oregon side, approving the location and plan of the canal as prepared by Maj. Wilson, but recommended that the dimensions of the locks should be increased to 300 f. in length instead of 250 f., and to 50 f. in width instead of 46 f., **78**, 138, 1333. Report, **78**, 1340. Approved by Chief of Engineers, **78**, 138. (Lt. Cols. Alexander, Stewart, and Williamson, and Majs. Mendell and Wilson; Lt. Payson, recorder.)

Convened Aug., 1879, to consider questions to be submitted by Engineer officer in charge, **80**, 2298, 2305. Report, **80**, 2305. (Lt. Cols. Stewart and Mendell and Maj. Gillespie.)

Reconvened Nov., 1880. Report, **81**, 2572. (Lt. Cols. Stewart, Williamson, and Mendell, Majs. Weitzel, Houston, and Gillespie.)

Convened at Washington, D. C., Feb. 24, 1888, by S. O., No. 7, to consider and report upon plan submitted by Capt. Powell for lock construction at the Cascades. Report, **88**, 2170. (Col. Craighill, Lt. Col. Gillespie, and Maj. Post.)

Convened at Portland, Oreg., Aug. 24, by S. O., No. 28, to consider and report upon modifications in existing project proposed by Maj. Handbury. Report, **89**, 2558. (Cols. Mendell and Craighill and Maj. Post.)

Convened at Portland, Oreg., Oct. 15, 1894, under S. O., No. 51, dated Sept. 24, 1894, to consider and report upon modifications in the plans for the Cascade locks. Report, **95**, 3576. (Col. G. H. Mendell, Col. W. P. Craighill, and Capt. W. L. Marshall.)

ENGINEERS IN CHARGE:

Maj. N. Michler, 1875–76. Reports, **75**, ii, 787; **76**, ii, 639.

Maj. J. M. Wilson, 1876–78. Reports, **76**, ii, 666; **77**, 1046; **78**, 1333; **79**, 1790.

Maj. G. L. Gillespie, 1878–81. Reports, **79**, 1848; **80**, 2298, 2309, 2311; **81**, 2563.

Capt. C. F. Powell, 1881–87. Reports, **82**, 2664; **83**, 2043; **84**, 2246; **87**, 2476.

Maj. W. A. Jones, 1884–86. Reports, **85**, 2426; **86**, 1924.

Maj. T. H. Handbury, 1888–93. Re-

## COLUMBIA RIVER—Continued.

### Part B.—Columbia River, Oreg.—Continued.

ports, **88**, 2161; **89**, 2543, 2551; **90**, 3052; **91**, 3328; **92**, 2819; **93**, 3506.

Capt. J. C. Post, 1894–95. Reports, **94**, 2645; **95**, 3568.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3266; **97**, 3416; (Maj.), **98**, 2981.

Capt. W. W. Harts, 1898–. Reports, **99**, 584; **1900**, 658.

Assistants:

C. M. Bolton, **77**, 1046. Reports, **78**, 1338; **79**, 1846.

Lt. C. F. Powell. Reports, **79**, 1846; **80**, 2302, 2310; **86**, 2567.

Lt. P. M. Price. Reports, **82**, 2669; **83**, 2047.

Lt. W. Young. Reports, **84**, 2249; **85**, 2430; **86**, 1945; **87**, 2481.

Lt. E. Burr. Reports, **88**, 2165; **89**, 2547; **90**, 3054; **91**, 3332.

Lt. H. Taylor. Reports, **92**, 2823; **93**, 3512; **94**, 2648; **95**, 3582.

W. E. Morris. Report, **96**, 3269.

W. G. Brown. Report, **97**, 3420.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Wilson, 1877, canal around the Cascades, navigable at all stages when the river is not closed by ice, $1,544,545, **77**, 1047.

By Board of Engineers, 1877, extension of breakwater to upper end of Bradford's Island, 1½ miles, and an additional lock, $1,000,000, making cost of canal $2,544,545, **78**, 1341, 1343.

By Maj. Wilson, increasing width of locks from 50 f. to 70 f., $30,000, **78**, 138.

**Legal proceedings.**

Oregon Steam Navigation Co. would sell the land for the canal to the United States for $200 per acre, reserving the right of way across for a railroad; the Secretary of War declined to purchase on these conditions, **78**, 1335. The Chief of Engineers ordered the condemnation of the land under the laws of Oregon, **78**, 1335. Objections by the Oregon Steam Navigation Co. to the condemnation of the lands, **78** 1,335.

**Legislation.**

By Oregon, authorizing the United States to take proceedings for condemnation of all land required for canal purposes, provided such property could not be purchased, **78**, 1335.

By Oregon, Oct. 16, 1878, granting the United States jurisdiction over lands condemned for canal purposes, **79**, 1790.

**Operations.**

**1878–79.** 7,228 c. y. earth, 4,316 c. y. loose rock, and 8,387 c. y. solid rock excavated; 80,994 pounds of cast-iron pipe furnished, **79**, 181, 1846.

Delay caused by the death of Mr. Ball, **79**, 1844, 1851.

**1879–80.** By contract 28,944 c. y. earth, 12,102 c. y. of loose and 26,640 c. y. of solid rock removed from canal prism, 186,292 pounds iron pipe, and 1,398 c. y. of masonry stone delivered. By hired labor, 35,080 c. y. excavated and 273 c. y. masonry laid, **80**, 2300, 2305.

**1880–81.** Progress on excavation of canal prism by hired labor, **81**, 2568.

**1881–82.** Progress on canal construction by hired labor, **82**, 2664, 2669; 4,527 c. y. bowlders removed from area adjacent to canal by contract, and 8,348 c. y. by hired labor, **82**, 2665, 2671. Drilling and blasting by hired labor, **82**, 2666. Cost of rock removal by surface blasting, **82**, 2672.

**1882–83.** Progress on canal construction by hired labor, **83**, 2043, 2048. Borings to determine site of lock, **83**, 2044. Rock removal in river below site of canal, **83**, 2045, 2051. Cost of rock removal, **83**, 2051.

**1883–84.** Progress on canal construction, **84**, 2246, 2249. Rock removal in river, **84**, 2246, 2251. Records of rock removal, **84**, 2247, 2251, 2253. Cost of rock removal, **84**, 2252.

**1884–85.** Progress on canal construction, **85**, 2429, 2431. Rock removal in river, **85**, 2434. Cost and details of rock removal, **85**, 2435.

**1885–86.** Progress on canal construction, **86**, 1945.

**1886–87.** 58,000 c. y. of rock removed at lock-site; stone-cutting, quarrying, and canal-paving in progress, **87**, 2482. Cost of rock removal, **87**, 2482.

**1887–88.** 22,645 c. y. excavated from canal prism and caisson chamber; 12,365 c. y. used in grading; 130 f. of wing wall completed; excavation of lock chamber completed and concrete foundation laid; 1,321 c. y. rubble used in paving slopes of upper canal entrance; 132 c. y. stone quarried, **88**, 2165–2168.

**1888–89.** 95,981 c. y. bed rock and 15,698 c. y. gravel excavated; 1,965 c. y. of canal wall laid; 5,035 c. y. of stone cut; 430 c. y. bowlders quarried; plant construction, **89**, 2547–2550.

**1889–90.** 6,038 c. y. bed rock and 1,853 c. y. bowlders excavated; 1,636 c. y. concrete made and laid; pivot stones placed; construction of tail-bay walls begun; 335 c. y. basalt stone quarried, **90**, 3053.

**1890–91.** 8,711 c. y. of dimension stone, 12,520 c. y. of dimension basalt, and 42,988 c. f. of faced basalt cut; 1,544 c. f. of stone laid in lock walls; 260 c. y.

## COLUMBIA RIVER—Continued.

### Part B.—Columbia River, Oreg.—Continued.

stone laid in canal walls; 9,614 c. y. of concrete made and placed; 2,085 c. y. bed rock and 4,443 c. y. gravel and sand excavated in preparation of lock masonry foundations; repairs to plant, **91**, 3329, 3330.

**1891-92.** 81,320 c. f. dimension granite, basalt, basalt-face stone, and dimension stone cut; 604 c. y. rubble quarried; 2,988 c. y. stone laid in lock walls; 260 c. y. stone laid in canal walls; 17,899 c. y. concrete made and laid; 8,033 c. y. excavated and used for filling in behind walls; 21,214 c. y. masonry used in construction of north abutment of lower lock and guard gates, and south wall of lock chamber, **92**, 2824.

**1892-93.** Preparations made for continuance of work, **93**, 3508.

**1893-94.** 2,575 c. y. masonry and 15,634 c. y. concrete laid; 20,785 c. y. rock and 35,267 c. y. other material excavated, **94**, 2647.

**1894-95.** 17,230 c. y. masonry, 27,050 c. y. concrete, and 1,160 c. y. paving laid; 18,483 c. y. rock and 81,946 c. y. loose material excavated. The lower guard and lock gates completed and the upper guard gates put in place, **95**, 3570.

**1895-96.** 192,894 c. y. rock and earth excavated. Masonry work completed and gates and machinery set, **96**, 3267.

**1896-97.** Revetting done, portions of north and south walls raised, and lock opened to navigation on Nov. 5, 1896, **97**, 3418.

**1897-98.** Raising of embankment and revetting in progress; stone gathered for completing walls and additional machinery placed, **98**, 2981, 2982.

**1898-99.** Revetting in progress; stone quarried for building walls of upper lock, preparations made for construction of movable dam, paving in progress, 1,417 s. y. facing for slope pavements quarried (photographs showing condition of works), **99**, 3223, 3224.

**1899-1900.** Protection embankment or wing separating the lower entrance to the canal from the river rebuilt and slope wall on the south side of the lower entrance to the canal repaired; movable dam built ready to put in place (plates; photographs), **1900**, 4327, 4328.

**Physical characteristics.**

General characteristics of the Cascades, **75**, ii, 787.

Action of ice at Hell Gate, **75**, ii, 780, 788.

Difference between extreme h. and l. w., **75**, ii, 789.

Record of flood levels, **75**, ii, 791.

Velocity of river, **79**, 1851.

Cascades a series of rapids, with a fall of 37.3 f. in a distance of 5¾ miles, **76**, ii, 667.

Current velocities at Cascades, **80**, 2306.

Movement of earth of rocky slopes about the Cascades, **80**, 2313.

High-water stages, **81**, 2569; **85**, 2429.

Rain-fall records, **83**, 2048; **84**, 2251, **85**, 2438; **86**, 1947; **87**, 2485.

Drainage areas of river, **85**, 2426.

Fall of river at Cascades, **85**, 2428.

Highest water recorded on the Columbia in 1894, **94**, 2647. Report on, by Maj. Post, **95**, 3572.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Michler, 1875, canal and locks around the Cascades of the Columbia, through solid rock, 2,600 f. long; rise at l. w., 21 f.; 3 locks, 215 f. long, 40 f. wide, and 16½ f. deep; lift of each, 7 f.; estimate, $700,000, **75**, ii, 772, 789.

By Maj. Wilson, 1877, canal around the Cascades, navigable when the river is not higher than 25 f. above l. w.; estimate, $1,188,680, **77**, 1047.

By Board of Engineers, 1877, extension of breakwater to upper end of Bradfords Island, 1½ miles, and an additional lock; estimate, $1,000,000. **78**, 1341.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Wilson, 1877, as modified by the Board of Engineers, canal around the Cascades, on left bank, or Oregon side, 7,200 f. long, 50 f. wide, and 8 f. deep at l. w., with two locks, 300 f. long, 50 f. wide, and 8 f. deep at l. w., to be navigable at all stages when the river is not closed by ice; estimate, $1,544, 545, **77**, 1047; **78**, 138, 1333.

By Maj. Wilson, 1878, increased width of locks from 50 f. to 70 f.; estimate, $30,000, **78**, 138, 1338. Approved by the Chief of Engineers and Secretary of War, **78**, 138, 1339. Dimensions of canal, **79**, 1849.

The Board of Engineers, 1879, recommended the improvement of the low-water navigation through the reefs below the canal before the commencement of the construction of the lock masonry, **80**, 2307, 2314; **81**, 2571.

In 1880 the project was modified by the Board of Engineers to provide for navigation from l. w. to a stage 20 f. above; the construction of a single lock near the foot of the rapids 462 f. long, 90 f. wide, and with a lift of 24 f., the gates to be 70 f. wide; canal prism, about 3,000 f. long, 90 f. wide at bottom, and 8 f. deep, **81**, 327, 2564, 2576.

In 1882, to provide for modifications of project and improvement of channel below canal, a revision of estimate was made, **81**, 321.

## COLUMBIA RIVER—Continued.

### Part B.—Columbia River, Oreg.—Continued.

Amount appropriated from 1876 to 1882, $805,000; amount required to complete project, $1,655,397.31, **82**, 2667; total, $2,460,397.31, **83**, 2043.

In 1885 it was proposed to make the widths of the gates equal to width of lock, **85**, 2429.

Increased width of 90 f. approved by Board of Engineers in 1886, **86**, 1945.

Total amount appropriated to 1886, $1,142,500, **86**, 1945.

Amount required to complete project, $1,100,000, **86**, 359.

In 1887 a revision of the estimates made the total estimated cost of the work $2,992,500, **87**, 2477, 2480.

In 1888 the Board of Engineers, to which Capt. Powell's plan for lock construction at the Cascades was submitted, considered that the project for the construction of the Cascades Canal should be limited to providing for navigation up to a stage of 20 f. above l. w., giving practically an all-year-round navigation, the location and dimensions of the lock to remain as proposed by the Board of 1880, and the upper guard gate of the lock to be omitted; width of canal above the lock to be increased to 250 f., and below to 140 f., **88**, 2170–2174.

In 1888 iron was substituted for wood in the construction of the lock gates, **89**, 2558.

In 1890, after completing the details in the project for the lock and upper guard gates at the Cascades, Maj. Handbury estimated the cost of completing the project at $1,745,516, **91**, 3346, 3361.

By Board of Engineers, 1894, for utilization of a part of the canal between the upper gates of the lock and the upper guard gates as a second lock by putting in a concrete floor and side walls, to make the canal available for all stages up to 42 f. above l. w. of the lower gauge; for modifying the details of the protection works to make them conform to the highest flood tide, that of 1894, and for maintenance; estimate, $413,360. **95**, 3582; **96**, 3266.

By Capt. Fisk, 1896, for raising the height of the north wall to 34 f. and a part of the south wall 12 f., to enable the locks to be safely operated to very nearly the highest stage at which boats could reach them through the rapids at the foot of the Cascades, **97**, 3418.

Outline of modified project and status of work under it, **99**, 3222, **1900**, 4324.

**Surveys.**

Cascades and Dalles of the Columbia, 1874, under direction of Maj. Michler, by R. A. Habersham, **75**, 125; ii, 787; **76**, ii, 639. Reports, **75**, ii, 787, 790.

Washington Territory side of Cascades, by C. M. Bolton, **77**, 1047, 1048. Report, **78**, 1338.

Cascades, **81**, 1879–80, 2563.

MAPS.

Of proposed canal, **78**, 1338.

Sketch of profile along center line of the canal, showing excavation up to June 30, 1879, **79**, 1846.

Cascades, **83**, 2046; **84**, 2246, 2252; **85**, 2434.

River, **85**, 2426; **89**, 2550.

PHOTOGRAPHS, **99**, 3224; **1900**, 4328.

### Part C.—Columbia River, Oreg. and Wash. (See *Willamette and Columbia rivers, from Portland, Oreg., to the sea.*)

**Appropriations.**

| | |
|---|---|
| 1878, | $5,000, **79**, 182, 1791. |
| 1879, | 5,000, **79**, 182. |
| 1882, | 7,500, **83**, 2010. |
| 1884, | 100,000, **84**, 2224. |
| 1886, | 187,500, **86**, 1976. |
| 1888, | 500,000, **88**, 2158. |
| 1890, | 75,000,<br>475,000, **90**, 3016. |
| 1892, | 350,000, **92**, 2811. |
| 1894, | 338,180, **95**, 3554. |
| 1900, | 250,000, **1900**, 4362. |
| Total, | [a] 2,293,180 |

**Commerce.**

Commerce to be benefited, **81**, 2537; **83**, 2011, 2031; **84**, 2225; **86**, 1974, 1983; **87**, 2473, 2474.

Delay due to bar, **84**, 2223.

Draft of vessels entering river, **84**, 2223.

Tonnage out and in bound over Columbia River bar for 1891–92, **92**, 2817.

Comparative statement of principal exports from 1883 to 1892, **92**, 2818.

Description of, **1900**, 4433, 4454.

Extensive interests, 1899, would be benefited by improvement of the river mouth, **1900**, 4433.

**Contracts.**

**1885.** L. W. Holt, wharf and trestle at Point Adams, **85**, 2385. J. F. Steffen, 4 stone barges, **85**, 2385. P. F. Falbert, piles, **85**, 2387. L. Michael, riprap stone, **85**, 2387.

**1886.** Oregon Paving Co., piles and stone, **87**, 2474.

**1889.** P. Hinkle, rock, 64 cents per ton, **89**, 2531. C. P. Church, fascines, $2.74 per cord, and poles, 24 cents each **89**, 2531. Paquet & Smith, 4 barges, $5,870 each, **89**, 2533.

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[a] $50,000 of this made available by act of June 3, 1896, for improvement below Tongue Point.

## COLUMBIA RIVER—Continued.

### Part C.—Columbia River, Oreg. and Wash.—Continued.

**1890.** C. P. Church, fascines $2.84 per cord, and poles 23¾ cents each, **90**, 3014. J. E. Smith, rock, 63½ cents per ton, **91**, 3319.

**1891.** R. Hoyt, fascines $2.70 per cord, and poles 22 cents each, **91**, 3319,

**1893.** W. H. Maxwell and O. Huber, stone, 63½ cents per s. t. ($63,500), **93**, 3492.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 240; **83**, 332, 2011; **84**, 335; **85**, 364; **86**, 360; **87**, 327; **88**, 301; **89**, 358; **90**, 325; **91**, 412; **92**, 386; **93**, 447; **94**, 413; **95**, 460; **96**, 400; **97**, 502; **98**, 507; **99**, 595; **1900**, 671, 676.

BOARDS OF ENGINEERS:

Convened at New York, Feb. 12, 1881, to consider the improvement of the mouth of the Columbia River. The Board did not consider it necessary at that time to submit any plan for improvement, **81**, 2548, 2552. (Cols. Tower and Newton and Lt. Col. Abbot.)

Board constituted by S. O. No. 82, C. of E., 1882, to report upon a plan for the permanent improvement of the mouth of the river. Report, **83**, 2012. (See also *Projects.*) (Lt. Cols. Stewart, Craighill, Comstock, and Mendell and Capt. Powell.)

Convened at Portland, Oreg., by S. O. No. 4, dated Feb. 11, 1893, for the purpose of considering and reporting upon the completion of the work. Report, **93**, 3499. (Col. G. H. Mendell, Maj. W. H. Heuer, Maj. T. H. Handbury.)

ENGINEERS IN CHARGE:

Maj. G. L. Gillespie, 1878–81. Reports, **80**, 2315, 2318; **81**, 2534, 2536.

Capt. C. F. Powell, 1881–87. Reports, **82**, 2647; **83**, 2010; **84**, 2222; **85**, 2382; **86**, 1972; **87**, 2470.

Maj. T. H. Handbury, 1888–93. Reports, **88**, 2155; **89**, 2529; **90**, 3011, 3025; **91**, 3314; **92**, 2808; **93**, 3488.

Maj. J. C. Post, 1894–95. Reports, **94**, 2631; **95**, 3551.

Capt. W. L. Fisk, 1896–99. Reports, **96**, 3250; **97**, 3404; (Maj.), **98**, 3040; **99**, 3246.

Capt. W. C. Langfitt, 1899.

Capt. W. W. Harts, 1899–. Reports, **1900**, 4361, 4430, 4434.

ASSISTANTS:

R. A. Habersham. Report, **80**, 2317.

G. M. Jessen. Report, **80**, 2321.

Lt. E. Burr. Report, **86**, 1976.

P. W. Eastwick. Report, **86**, 1980.

G. B. Hegardt. Reports, **89**, 2535; **90**, 3017; **91**, 3320; **92**, 2811; **93**, 3492; **94**, 2634; **95**, 3555; **96**, 3253; **1900**, 4440.

**Operations.**

**1879–80.** Survey of mouth, and efforts to increase channel depth of Sand Island Shoal by scraping, **80**, 2315.

**1880–81.** Survey of mouth continued; efforts to increase depth over bar by harrowing, **81**, 2534, 2547.

**1881–84.** Continuation of surveys and studies for plans of improvement, **84**, 2222.

**1884–85.** Construction and purchase of plant and commencement of work by hired labor on tramway for construction of jetty, **85**, 2383.

**1885–86.** 1,944 c. y. brush mattress and 3,346 c. y. of stone placed in the jetty; 1,090 l. f. of jetty tramway built, **86**, 1973. Methods of construction, **86**, 1981.

**1886–87.** Difficulties of stone transportation; construction of tramway in progress, **87**, 2471, 2472.

**1887–88.** Jetty tramway extended 2,500 f.; 1,400 l. f. of mattress built; 20,315 tons stone placed in jetty, **88**, 2156.

**1888–89.** 63,468 tons of rock placed in jetty; 4,176 l. f. of tramway built; 4,432 l. f. of mattress built; track and wharf construction and repairs to plant, **89**, 2535–2540.

**1889–90.** Mattress foundation and tramway construction advanced 1.7 miles; construction of pile driver and repairs to plant; 120,354 tons rock placed in jetty, **90**, 3012–3014.

**1890–91.** 4,128 tons of rock and 4,400 cords of fascines received and placed in the jetty; 1,700 l. f. of shore-trestle piling renewed; repairs to tracks, tramways, and plant, **91**, 3314–3317.

**1891–92.** Tramway extended 1,088 f.; 30,000 tons of rock dumped in widened portion of end of the jetty; 25,000 tons of rock used in securing the root of the jetty; 1,768 cords of fascines and 3,528 poles used in mattress construction, **92**, 2808, 2809.

**1892–93.** 131,608 tons rock placed in jetty and repairs made, **93**, 3489.

**1893–94.** 115,738 tons rock placed in jetty and groins, **94**, 2632.

**1894–95.** 136,900 tons rock placed in jetty, groins, and shore revetment, **95**, 3553.

**1895–96.** 82,791 tons rock placed in jetty and shore revetment; work considered as completed, **96**, 3251.

**Physical characteristics.**

Description of mouth, **83**, 2012.

Movement of shore lines, **80**, 2316, 2317, 2318; **81**, 2540; **83**, 2021; **86**, 1978, 1980.

Low-water cross section, mouth, **83**, 2012.

## COLUMBIA RIVER—Continued.

### Part C.—Columbia River, Oreg. and Wash.—Continued.

Stages of water on the bar, **81**, 2542; **86**, 1979.

Description of ocean bed, **83**, 2026; **86**, 1978.

Tidal velocities, **83**, 2013.

Tidal data, **81**, 2550; **83**, 2027.

Tidal prism, **83**, 2013.

Force and direction of wind, **83**, 2028.

Discharge, **86**, 2010.

Description of, **93**, 3489, 3499; **95**, 3553.

Survey, 1898, showed a least depth on the bar of 29 f., 1 f. less than the preceding year; survey, 1899, showed 28 f. depth, **99**, 3246; survey, 1900, showed 23–24 f., **1900**, 4361.

Description of mouth, 1899, **1900**, 4433. Effect of the jetty and cause of shoaling over the bar, **1900**, 4436.

The mouth of the Columbia the only deep-water harbor for 700 miles on the Pacific coast and the only fresh-water harbor there, **1900**, 4438.

**Plans.** (See *Projects.*)

By Maj. Gillespie, 1879, dike about 10,000 f. long, of large rubblestone, extending from the inside of Point Adams along the east edge of Clatsop Spit to the 4-fathom curve in the south channel, the dike to rise about 3 f. above low water and to have a top width of 25 f.; estimate, $4,750,000, **80**, 2320; **81**, 2546.

In 1880 Maj. Gillespie proposed a pile dike about 8,000 f. long, filled with fascines and stone, starting at the northeast corner of Fort Stevens and following the 12-f. curve around Clatsop Spit; estimate, $430,000, **81**, 2547, 2548. Plan not approved by Board of Engineers of 1881, **81**, 2535, 2552. Board did not consider it necessary to submit any plan for improvement, **81**, 2552.

**Projects.**

By Board of Engineers, 1882, jetty, slightly convex to the north, extending from the shore near Fort Stevens in a northwesterly direction toward a point about 3 miles south of Cape Disappointment; the jetty to consist of random stone placed on a mattress foundation, and to be about 2,400 f. in length, with its top at low water, and a width not less than 5 f.; the outer 7,500 f. of the jetty to be faced with beton blocks of from 5 to 20 c. y. each; estimate, $3,710,000, **83**, 2018; **87**, 2470. Lt. Col. Mendell, differing on some points from the majority of the Board, submitted a minority report, **83**, 2034. Congress authorized commencement of improvements recommended by majority of Board, **84**, 402.

In 1890 the cost of completion was reduced from $2,423,000, in 1889, to $525,000, **90**, 3016; **91**, 3319.

By Board of Engineers, 1893, modification of former project to provide for raising the jetty, and for the construction of four low groins out from the main jetty to aid in the increase and permanency of any sand that might accumulate on the north side of the jetty; estimate, $583,203.50, **93**, 3502.

In 1896 $50,000 was transferred from this work by act of June 3, 1896, to the project for the improvement of the river below Tongue Point, **96**, 3253.

Capt. Langfitt estimated, 1899, it would cost $2,531,140.51 to form a 40-f. channel by extending the jetty, if the money were appropriated at once, **1900**, 4439.

Congress, 1900, appropriated $250,000 for repair of the jetty at the mouth of the river, **1900**, 4362.

**Surveys.**

Ordered by act of Mar. 3, 1879, **80**, 2315, made under direction of Maj. Gillespie, 1879, **80**, 2315, 2318, 2319; continued, **81**, 2538, 2550; **86**, 1976.

Comparison of various surveys, **81**, 2549; **83**, 2014, 2021.

Survey of the mouth of the river, made, 1891, under direction of Maj. Handbury, **91**, 3325.

Surveys of the bar at the mouth of the river, made, 1892, under direction of Maj. Handbury, **92**, 2810.

Miscellaneous surveys, **94**, 2639; **95**, 3553; **96**, 3252; **97**, 3405; **98**, 3040; **99**, 3246.

Examination and survey of the mouth for a 40-f. channel ordered by act of Mar. 3, 1889. Preliminary examination made, 1899, by Maj. Fisk (map), **99**, 3246 (report favorable); **99**, 3246; **1900**, 4434. Survey made by Capt. Langfitt, 1899 (see *Projects;* report favorable), **1900**, 4434.

MAPS. **81**, 2546, 2552; **86**, 1978, 1980; **88**, 2156; **89**, 2534; **90**, 3022; **91**, 3325; **93**, 3496; **94**, 2640; **95**, 3560; **99**, 3246; **1900**, 4362.

### Part D.—Columbia River, Oreg. (Gauging of Waters). (See *Willamette and Columbia rivers.*)

**Appropriations.**

1882, $500, **83**, 2076.
1884, 1,000, **84**, 2292.
1886, 1,000, **86**, 2010.
1888, 2,500, **89**, 2177.
1894, 1,000, **95**, 3596.
1896, 1,000, **96**, 3284.
1899, 1,000, **99**, 3250.

Total, 8,000

## COLUMBIA RIVER—Continued.

### Part D.—Columbia River, Oreg.—Continued.

**Commerce.**

Much benefited by the gauges established, **93**, 3528.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 457; **94**, 418; **95**, 466; **96**, 405; **97**, 507; **98**, 509; **99**, 598; **1900**, 675.

ENGINEERS IN CHARGE:

Maj. T. H. Handbury, 1888–93. Report, **93**, 3528.

Maj. S. C. Post, 1894–95. Reports, **94**, 2664; **95**, 3596.

Capt. W. L. Fisk, 1896–99. Reports, **96**, 3283; **97**, 3432; (Maj.) **98**, 3042; **99**, 3250.

Capt. W. C. Langfitt, 1899.

Capt. W. W. Harts, 1899 —. Report, **1900**, 4368.

**Projects.**

Gauge removed from Astoria to Fort Stevens, 1899, for more economical maintenance, **1900**, 4368.

### Part E.—Columbia River (Upper), Wash.

**Appropriations.**

1890, $70,000.00, **91**, 3229.
1897, 15.65, act July 19.

Total, 70,015.65

**Commerce.**

Description of, **93**, 3382.

In 1893 it was small, and there were signs of a decrease, **93**, 3382.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 364; **90**, 329; **91**, 406; **92**, 381; **93**, 439; **94**, 409; **95**, 449.

ENGINEERS IN CHARGE:

Maj. W. A. Jones, 1888–90. Report, **90**, 3065, 3069.

Maj. T. H. Handbury, 1890–91. Report, **90**, 3066.

Capt. T. W. Symons, 1891–95. Reports, **91**, 3223; **92**, 2716; **93**, 3378; **94**, 2593; **95**, 3393.

ASSISTANTS:

J. C. Ensign. Report, **90**, 3067.

J. G. Holcombe. Reports, **91**, 3230; **92**, 2718.

Wm. Cuthbert. Report, **93**, 3391.

**Operations.**

**1890–91.** Rock removal begun at Priest and Cabinet rapids; 15 ringbolts and 6 buoys placed at Priest Rapids, **91**, 3230.

**1891–92.** 12,199 c. y. rock blasted and removed at Cabinet Rapids; 1,894 c. y. rock removed at Rock Island Rapids, **92**, 2717.

**Physical characteristics.**

Description of, **90**, 3069.

Description of, international boundary line to the mouth of the Okanogan River, **93**, 3381.

Volume of water; current velocities; slopes; numerous falls, rapids, and dangerous rocks, **93**, 3384.

Some of the obstructions can not be passed or made passable by any system of regulating, **93**, 3384.

List of obstructions, **93**, 3384.

Table of distances, **93**, 3397.

List of bench marks, memorandum of falls and levels at low-water stage, and rates of flow of water in most rapid places, Upper Columbia River, **93**, 3398, 3399.

**Plans.** (See *Projects.*)

By Maj. Jones, 1890, opening to navigation the reach of river including Priest, Cabinet, and Rock Island rapids, by means of auxiliary water power; estimate, $138,000; with steam plant, estimate, $151,000, **90**, 3074, 3075.

**Projects.** (See *Plans.*)

By Capt. Symons, 1890, Rock Island, Cabinet, and Priest Rapids, removal of rock and putting in at all locations where they would be convenient iron posts and ringbolts to which ascending boats could make fast their lines and wind themselves up over the rapids with their steam capstans; estimate, $550,000, **91**, 3224–3225; **92**, 2716.

In 1893 Capt. Symons estimated it would cost $18,025,000 to improve the river, the international boundary line to the mouth of the Okanogan River, **93**, 3390.

**Surveys.**

Survey between Wallula and the British line, ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Handbury, **90**, 3066.

Survey from the head of Rock Island Rapids to the international boundary line, made, 1891, under direction of Capt. Symons, **91**, 3232.

Survey of the Columbia River, international boundary line to Rock Island Rapids, ordered by act of Sept. 19, 1890; report submitted by Capt. Symons, 1893, covering such a survey to the mouth of the Okanogan River only (see *Projects*), **93**, 3381.

MAPS. **92**, 124, 125, 126, 127, 128, 129.

## COLUMBIA RIVER—Continued.

### Part F.—Columbia River, Clarks Fork.

**Engineers.**

Chief of Engineers. Report, **91**, 409.

Engineer in Charge. Capt. T. W. Symons. Report, **91**, 3250.

Assistant. Wm. Cuthbert. Report, **91**, 3254.

**Physical characteristics.**

Description of, **91**, 3250.

**Surveys.**

Examination, international boundary line to mouth of Big Blackfoot River, ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Symons (report unfavorable), **91**, 3250.

### Part G.—Columbia River, at Three-Mile Rapids, and Boat Railway from The Dalles Rapids to Celilo Falls.

**Appropriations.**

| | |
|---|---|
| 1888, | [a]$15,000, **90**, 3030. |
| 1892, | [a]20,000, act July 13. |
| 1894, | 100,000, **95**, 3591. |
| 1896, | 150,000, **96**, 3281. |
| Total, | 270,000 |

**Commerce.**

Description of, **82**, 2695, 2696; **94**, 2666.

Population and products of the adjacent country rapidly increasing, **94**, 2667.

**Engineers.**

Chief of Engineers. Reports, **80**, 242; **81**, 332; **90**, 3028; **93**, 458; **94**, 418; **95**, 464; **96**, 404; **97**, 505; **98**, 495; **99**, 582; **1900**, 655.

Boards of Engineers:

Convened at Portland ,Oreg., Aug. 21, 1888, to report upon project for overcoming obstructions to navigation in the Columbia River at The Dalles and Celilo Falls, and at Three and Ten Mile Rapids. Report, **90**, 3030. (Cols. Mendell and Craighill and Maj. Post.)

A Board of Engineers, three members from civil life, convened at San Francisco Oct. 17, 1892, by direction of S. O. No. 177, dated July 29, 1892, for examination into the obstruction of Columbia River in that portion from the navigable waters below Three Mile Rapids to the navigable waters above Celilo Falls, and to report what they believed to be the best plan for overcoming the difficulties of navigation of the portion of the stream under consideration. Report, **94**, 2664. (Col. G. H. Mendell, Lt. Col. C. R. Suter, Lt. Col. W. R. King, Maj. C. J. Allen, Corps of Engineers; Wm. R. Hutton, Virgil G. Bogue, and E. P. Alexander.)

Engineers in Charge:

Capt. C. W. Powell. Report, **82**, 2690.

Maj. T. H. Handbury, 1893.

Maj. J. C. Post, 1894–95. Reports, **94**, 2664; **95**, 3589.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3279; **97**, 3425; (Maj.) **98**, 2979.

Capt. W. W. Harts, 1898–. Reports, **99**, 3221; **1900**, 4322.

Assistants:

Lt. E. Burr, **90**, 3044.

(Description of boat railway and appliances), **94**, 2675.

O. R. Pihl. Report, **97**, 3427.

**Legal proceedings.**

Condemnation proceedings to obtain right of way across certain lands; damages awarded, **96**, 3280.

Description of lands obtained by condemnation proceedings, purchase, etc.; damages awarded by new trials, **97**, 3426; **98**, 2980.

Title to some lands secured, **99**, 3221.

Agreement made by which the Oregon R. R. & Navigation Co. surrendered to the U. S. 72.58 acres for the boat railway, the U. S. to furnish the R. R. Co. with 26.75 acres of other land and to pay the actual cost of the relocation of the tracks of the railway, etc.; estimated cost to the U. S. $88,493.20. Not approved at end of fiscal year 1900 by Secretary of War, **1900**, 4322.

**Operations.**

**1899–1900.** Repairs made to Government steamer *Cascades*, **1900**, 4323.

**Physical characteristics.**

Description of, Dalles, **82**, 2692, 2695.

Gauge readings, **82**, 2702.

River slope, **82**, 2693.

Current velocities, **82**, 2704.

Description of, **94**, 2665.

In the 12 miles of river covered by this improvement there is a total fall of about 80 feet at low water and 60 at high stages, **94**, 2666.

**Private work.**

Steps taken to build a private portage road by a number of persons, **99**, 3221.

**Plans.** (See *Projects.*)

By Capt. Powell, 1882:

(1) To carry the Celilo level by a canal with a lock at upper end to a flight of locks near gauge station No. 4, **82**, 2697.

(2) With lift-locks, as in (1), to dam the river, making the overfall into Big Eddy, **82**, 2697.

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[a] Survey.

## COLUMBIA RIVER—Continued.

### Part G.—Columbia River, at Three-Mile Rapids, and Boat Railway from The Dalles Rapids to Celilo Falls—Continued.

(3) Open river improvement for all stages to Celilo Falls and lockage at the falls, **82**, 2697.

(4) Open river improvement for lower stages to Celilo Falls; lockage from low to mean high water at falls; open passage over falls for higher stages and lockage at the Dalles Rapids, **82**, 2697.

Estimates, low-water project (1), (2), (3), $7,674,495; estimates, high-water project (1), (2), $2,842,848, **82**, 2699, 2711.

By Board of Engineers, 1889, removing boats from the river at the foot of Dalles Rapids and returning them to the river at the head of Celilo Falls by means of hydraulic lifts, one at each terminus, transporting them over the intermediate distance of 8 miles on a railway; also improvement of Three-Mile Rapid; estimate, $3,576,356, with an annual cost of $80,000 for maintenance, **90**, 3042.

By a minority of the Board of Engineers of 1892 for improving Three Mile Rapids below the lower terminus of the railway, at an estimated cost of $170,000; and for the construction of a boat railway beginning at Big Eddy and terminating above Celilo Falls, 9 miles in length, for the passage of boats, 8 of 600 tons each in each direction in twelve hours, on the south side of Columbia River, the railway to be provided at each terminal with hydraulic lifts, etc., for raising and lowering the boats from and to the tracks, estimate, $2,264,467 (including the cost of the Three Mile Rapids improvement), **94**, 2674, **95**, 3590.

Those interested in the navigation of the river preferred a portage road instead of the railway, **99**, 3222.

Photographs showing a few of the obstructions which the boat railway was designed to surmount, **99**, 3222.

Repairs to Government boat authorized at an estimated cost of $2,000, **1900**, 4323.

**Surveys.**

Ordered by act of Mar, 3, 1879, **80**, 242, made, 1880, under direction of Maj. Gillespie and Capt. Powell, **82**, 2690.

The line of the railroad definitely located, **96**, 3280.

MAPS. **95**, 3590.

### Part H.—Columbia River, between Vancouver, Wash., and the mouth of the Willamette River.

**Appropriations.**

| | | |
|---|---|---|
| 1892, | $33,000, | **93**, 3504. |
| 1896, | 67,000, | **96**, 3264. |
| Total, | 100,000 | |

**Contracts.**

**1892.** Borthwick & Davison, dam work—piles, 8½ cents per l. f.; lumber, $12 per M f.; bolts and washers, 3½ and 15 cents each; spikes and wire, 3¾ and 4 cents per pound; rock, 55 cents per ton; fascines, $2.35 per cord ($19,954.13), **93**, 3505. Annulled, **94**, 2643.

**1894.** R. Smith, repairs to dam, etc., aggregate amount of bid, $4,612.85, **94**, 2645.

**1897.** J. Hale, construction and repair of dam, aggregate amount of bid, $19,286.30, **98**, 2989.

**1899.** Wakefield & Jacobsen, dike extension—piles, lumber, ironwork, brush, stone, $14,686, **99**, 3231.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 421; **92**, 395; **93**, 449; **94**, 414; **95**, 462; **96**, 403; **97**, 504; **98**, 499; **99**, 586; **1900**, 661.

ENGINEERS IN CHARGE:

Maj. T. H. Handbury, 1890–93. Reports, **92**, 2865, 2866; **93**, 3503.

Maj. J. C. Post, 1894–95. Reports, **94**, 2643; **95**, 3566.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3263; **97**, 3414; (Maj.) **98**, 2987.

Capt. W. W. Harts, 1899–. Reports, **99**, 3229; **1900**, 4334.

**Operations.**

**1892–93.** About 2,800 f. of dam built, **93**, 3504.

**1893–94.** Repairs to dam made and revetment constructed, **94**, 2644.

**1894–95.** 103,638 c. y. dredged, **95**, 3567.

**1897–98.** Repair of and construction of dam and revetment in progress, **98**, 2988.

**1898–99.** Minor repairs made to dam built 1897–98; extension of Hayden Island end of dam for about 700 f., and construction of 2 cross dikes to connect the 700-f. extension with the head of Hayden Island; head of island protected with revetment (photographs), **99**, 3230,

**1899–1900.** Dike at head of Hayden Island repaired, **1900**, 4335.

**Physical characteristics.**

Description of, **92**, 2866; **96**, 3265.

Survey of 1899 showed that dike at Hayden Island had not produced the scour for which it was designed; scour not looked for then until two or three

## COLUMBIA RIVER—Continued.

### Part H.—Columbia River, between Vancouver, Wash., and the mouth of the Willamette River—Continued.

seasons of high and low stages had passed, **1900**, 4336.

**Projects.**

By Maj. Handbury, 1891, closing the chute behind Hayden Island opposite Vancouver by a pile, brush, and rock dam about 3,000 f. long and 4 f. high above low water, to throw the water passing down this chute at this stage into the main channel to remove a sand bar between the mouth of the Willamette and Vancouver; estimate, $33,000; **92**, 2868; **93**, 3503.

By Maj. Post, 1895, for completing the improvement by extending the dam 1,500 f. passing the head of Hayden Island and turning downstream at its outer end, the effect of the dam to be supplemented by dredging in the main channel; estimate; $67,000; **96**, 3264, 3265.

By Capt. Harts, 1899, for extension of main dike downstream for 700 f., this extension to be connected by 2 dikes with the head of Hayden Island; estimate, $16,000. Revised estimate, $25,516. **99**, 3229.

**Surveys.**

Survey ordered by act of September 19, 1890, made, 1891, under direction of Maj. Handbury, **92**, 2866.

Survey to determine the condition of the channel and to ascertain what further improvement was needed ordered by Chief of Engineers, 1895; report submitted by Maj. Post, 1895 (see *Projects*), **96**, 3264.

Survey made, 1899, to ascertain whether the dredging provided for by the existing project would be necessary, (see *Physical characteristics*), **1900**, 4335. (Maps.)

MAPS. **98**, 2988; **99**, 3230; **1900**, 4336.

PHOTOGRAPHS. **99**, 3230.

### Part I.—Columbia River, Rock Island Rapids to Foster Creek Rapids, Wash.

**Appropriation.**

1895, [a]$8,005.20, **95**, 3397.

**Commerce.**

This portion of the river is a waterway of considerable importance in connection with the transcontinental railroad line known as the Great Northern, **95**, 3534.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 450, 460; **96**, 413; **97**, 517.

ENGINEERS IN CHARGE:

Capt. T. W. Symons, 1895. Reports, **95**, 3395, 3534.

Capt. H. Taylor, 1896–97. Reports, **96**, 3380; **97**, 3455.

ASSISTANTS:

C. F. B. Haskell. Report, **95**, 3537.

P. G. Eastwick. Report, **95**, 3397.

**Operations.**

**1895–96.** 4,055 c. y. rock removed, **95**, 3398.

**1896–97.** Boom to aid in lining up constructed, **96**, 3381.

**Physical characteristics.**

Description of, **95**, 3395, 3534.

This part of the river is 80 miles long, and flows through a deep canyon having an average fall of 2.2 f. per mile. In 1895 the difficulties in the way of navigation were swift currents, known and unknown rocks, and rapids, **95**, 3395.

List of bench marks established, table showing distances of prominent places from the international boundary, from the mouth of the Columbia River, and elsewhere, and list of obstructions in the river, **95**, 3542, 3543.

**Projects.**

By Capt. Symons, 1895, removal of obstructing rocks at Rocky Reach, Methow Rapids, and where found necessary; and for proper apparatus for lining up of boats where necessary, **95**, 3396.

In 1895 Capt. Symons estimated it would cost $19,987 to improve this part of the river, **95**, 3537.

**Surveys.**

Survey of the river from Rock Island Rapids to Okanogan River ordered by act of Aug. 17, 1894, made, 1895, under the direction of Capt. Symons, (see *Projects*), **95**, 3534.

List of bench marks, **95**, 3542.

MAPS. **95**, 3542.

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[a] Unexpended balance for river between Rock Island Rapids and Priest Rapids.

## COLUMBIA RIVER—Continued.

### Part J.—Columbia River, below Tongue Point and in front of Astoria, Oreg.

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $50,000, | [a] **96**, 3257. |
| 1899, | 71,000, | **99**, 3245. |
| Total, | 121,000 | |

**Commerce.**

Large local and foreign commerce uses this channel, **95**, 3608.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 468; **96**, 401; **97**, 502; **98**, 507; **99**, 3245; **1900**, 4360.

ENGINEERS IN CHARGE:

Maj. J. C. Post, 1895. Report, **95**, 3605.

Capt. W. L. Fisk, 1896–99. Reports, **96**, 3256; **97**, 3406; (Maj.), **98**, 3039; **99**, 3245.

Capt. W. C. Langfitt, 1899.

Capt. W. W. Harts, 1899–. Report, **1900**, 4360.

**Operations.**

**1896–97.** 103,231 c. y. dredged, **97**, 3407.

**1897–98.** 59,150 c. y. dredged, **98**, 3039.

**1899–1900.** Preparations made for dredging, **1900**, 4360.

**Physical characteristics.**

Description of: channel extends along the front of Astoria to Smiths Point, a distance of 5½ miles, and forms the only navigable connection for vessels of deep draft between Columbia River above Tongue Point and the sea, **95**, 3605.

**Projects.**

By Maj. Post, 1895, removal of a wreck of a steamer and an outer portion of the ledge upon which it rested, supplementing the work by dredging a waterway in front of Astoria 25 f. deep and 250 f. wide at bottom, in accordance with the general project for improvement of the Columbia and lower Willamette from Portland to the sea; estimate, $121,550, **95**, 3608; **96**, 3256.

By Maj. Fisk, 1899, removal of 63,900 c. y. rock from Sylvia de Grasse reef, **99**, 3245.

**Survey.**

Survey of the river below Tongue Point by way of the southern channel in front of Astoria, ordered by act of Aug. 17, 1894; made, 1895, by Maj. Post (report favorable; see *Projects*), **95**, 3605.

MAPS. **95**, 3608.

## COLUMBIA RIVER, WASH., cascades, canal, and locks at (care and operation of).

**Appropriations.**[b]

| | |
|---|---|
| 1897, | $2,434.72 |
| 1898, | 4,533.79 |
| 1899, | 6,683.62 |
| 1900, | 5,296.13 |
| Total, | 18,948.26 |

**Commerce.**

Description of, **97**, 3424; **98**, 2985.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **97**, 505; **98**, 498; **99**, 586; **1900**, 661.

ENGINEERS IN CHARGE:

Capt. W. L. Fisk, 1897–98. Reports, **97**, 3423; (Maj.), **98**, 2983.

Capt. W. W. Harts, 1898–. Reports, **99**, 3224; **1900**, 4329.

**Operations.**

**1896–97.** Canal and locks formerly opened to navigation on Nov. 5, 1896. Repairs made to both lower culvert valves, **97**, 3423.

**1897–98.** About 2,000 c. y. dredged from lower entrance to canal; culvert repaired, **98**, 2983.

**1898–99.** Repairs to culverts, **99**, 3225.

**1899–1900.** Sand-blast machine for cleaning lock gates built; cleaning and painting of lock gates in progress; changes made in culverts, **1900**, 4330–4331.

**Physical characteristics.**

Meteorological observations and gauge records, **99**, 3228; **1900**, 4334.

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[a] This is the unexpended balance of the appropriation for the improvement of the mouth of Columbia River, Oreg. and Wash.

[b] Expenditures under permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

### COLUMBUS. (See *Chattahoochee River.*)

### COMBAHEE RIVER, S. C. (See *Lackahatchie River.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 158.

ENGINEER IN CHARGE. Capt. F. V. Abbot. Report, **89**, 1211.

**Physical characteristics.**

Description of, **89**, 1211.

**Survey.**

Examination to determine whether the breaking of Bull River into Combahee River, near the head of Bull River, would injure the navigation of Combahee River ordered by act of Aug. 11, 1888, made, 1888, under direction of Capt. Abbot, **89**, 1211.

### COMPTON'S CREEK, N. J. (See *Shoal Harbor, N. J.*)

### CONANICUT ISLAND, R. I. (See *Narragansett Bay, R. I.*)

**Commerce.**

Description of, **95**, 745; **97**, 928.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 72; **97**, 80.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1894–95. Report, **95**, 745.

Maj. D. W. Lockwood, 1896. Report, **97**, 928.

**Physical characteristics.**

Description of, **95**, 745; **97**, 929.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made by Capt. Bixby, 1895 (report unfavorable), **95**, 745.

Examination ordered by act of June 3, 1896, made by Maj. Lockwood, 1897 (report unfavorable), **97**, 928.

### CONASANGA RIVER. (See *Oostenaula River, Ga.*)

### CONECUH RIVER, ALA. AND FLA. (See *Escambia* and *Conecuh rivers.*)

### CONEMAUGH AND KISKIMINETAS RIVERS, PA.

**Commerce.**

Description, **79**, 1394.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 109; **79**, 147.

ENGINEER IN CHARGE. Maj. W. E. Merrill, 1878. **78**, 109. Report, **79**, 1388.

ASSISTANT. J. Worrall. Report, **79**, 1390.

**Physical characteristics.**

Fall of Conemaugh and Kiskiminetas rivers, between Johnstown and the Allegheny River, **79**, 1389.

Water supply by means of reservoirs sufficient, **79**, 1391.

**Plans.**

By J. Worrall, water communication Havre de Grace, Md., to Pittsburg, Pa., having vertical lockage of 2,700 f., divided into 3 sections: Eastern division, from mouth of the Susquehanna, along that and the Juniata rivers, to Frankstown, with a canal and slackwater navigation, requiring 912 f. of lockage, estimate, $10,720,000; difficulties in damming the Susquehanna River, **79**, 1392, 1393, 1397. Middle or mountainous division, from Frankstown, on the Juniata, to Johnstown, on the Conemaugh, by independent canals and partial slackwater navigation on the Conemaugh River, requiring 1,339 f. of lockage, by tunneling through the mountains, water supply by feeders from reservoirs; estimate, $15,607,000, **79**, 1392, 1393, 1397. Western division, from Johnstown, via Conemaugh, Kiskiminetas, and Allegheny rivers, to Pittsburg, by slackwater navigation, requiring 449 f. of lockage; estimate $4,518,700, **79**, 1393, 1396, 1397. Total estimate for single locks, $30,845,700; for double locks, $40,000,000, **79**, 1397.

List of reservoirs, **79**, 1395, 1397.

Discussion of advantages and disadvantages of slackwater navigation, **79**, 1392.

Discussion of possibility of surmounting all engineering difficulties, **79**, 1388, 1391.

**Private (State and corporate work).**

The "main line of Pennsylvania's public works," running from Philadelphia to Pittsburg, consisted of railway from Philadelphia to Columbia, canals from Columbia to the foot of the Allegheny Mountains, portage railway across the Alleghenies, and canal and slackwater navigation from Johnstown to Pittsburg, about 409 miles in length, **79**, 1390.

**CONEMAUGH AND KISKIMINETAS RIVERS, PA.**—Continued.

**Surveys.**
Under direction of Maj. Merrill, 1878–79, by J. Worrall, reconnoissance of Conemaugh and Kiskiminetas rivers; also a survey for water communication from Ohio River at Pittsburg, Pa., to the Chesapeake Bay at Havre de Grace, Md., via Allegheny, Kiskiminetas, Conemaugh, Juniata, and the Susquehanna rivers. Reports, **79**, 1388, 1390.

**CONEWANGO CREEK, N. Y. AND PA.** (See *Allegheny River.*)

**CONEY ISLAND CHANNEL, N. Y.**

**Commerce.**
The channel much used by small sailing vessels, steamers, and by scows loaded with refuse of New York City, **97**, 1049.

**Engineers.**
Chief of Engineers. Report, **97**, 115.
Engineer in Charge. Lt. Col. Wm. Ludlow, 1897. Report, **97**, 1048.

**Physical characteristics.**
Description of, **97**, 1049.

**Survey.**
An examination from Norton Point to bell buoy with a view to 16-f. depth ordered by act of June 3, 1896, made, 1896, by Col. Gillespie (report favorable), **97**, 1049.

**CONEY ISLAND CREEK, N. Y.**

**Commerce.**
Unimportant, **97**, 1051.

**Engineers.**
Chief of Engineers. Report, **97**, 115.
Engineer in Charge. Lt. Col. G. L. Gillespie, 1897. Report, **97**, 1050.
Assistant. A. Doerflinger. Report, **97**, 1051.

**Physical characteristics.**
Description of: Small creek, tidal, 200 to 50 f. wide, 2¼ miles long, crossed by many bridges, connecting Gravesend Bay with Sheepshead Bay, N. Y., and separating Coney Island from the mainland of Long Island, **97**, 1050.

**Survey.**
Examination ordered by act of June 3, 1896, made, 1896, by Lt. Col. Gillespie (report unfavorable), **97**, 1050.

**CONEY ISLAND POINT, N. Y.** (See *Long Island Coast.*)

**CONGAREE RIVER, S. C.** (See *Wateree River, S. C.*)

**Appropriations.**
1886, $7,500, **87**, 1095.
1888, 7,500, **88**, 945.
1890, 5,000, **90**, 1225.
1892, 5,000, **92**, 1218.
1894, 4,000, **95**, 1420.
1896, 2,000, **96**, 1180.
Total, 31,000

**Commerce.**
Important, **85**, 1140, 1142; **87**, 1093, 1096.
Description of, **93**, 1493; **94**, 1094, 1099; **95**, 1420; **96**, 1181, 1185.
In 1892–93 the freight carried on the river amounted to 2,781 tons, **93**, 1492; in 1893–94, 7,974 tons, **94**, 1093; in 1894–95, 8,993 tons, **95**, 1419; in 1895–96, 18,307 tons, **96**, 1180.

**Engineers.**
Chief of Engineers. Reports, **85**, 177; **87**, 138; **88**, 133; **89**, 156; **90**, 139; **91**, 174; **92**, 173; **93**, 187; **94**, 171; **95**, 196; **96**, 175; **97**, 221; **98**, 218; **99**, 251; **1900**, 285.
Engineers in Charge:
Capt. W. H. Bixby, 1885–89. Reports, **85**, 1140, 1143; **88**, 943.
Capt. F. V. Abbot, 1889–97. Reports, **89**, 1193; **90**, 1224; **91**, 1464; **92**, 1217; **93**, 1491; **94**, 1092; **95**, 1418; **96**, 1179; **97**, 1468.
Maj. E. H. Ruffner, 1898–99. Reports, **98**, 1280; **99**, 1539.
Capt. J. C. Sanford, 1900–. Report, **1900**, 1863.
Assistants:
S. McBee. Report, **85**, 1144.
R. H. Whitford. Reports, **85**, 1140, **87**, 1095; **88**, 946, **89**, 1194; **90**, 1226; **91**, 1466; **92**, 1218; **93**, 1493; **94**, 1093; **95**, 1420; **96**, 1181; **97**, 1470.

**Operations.**
**1886–87.** Partial removal of obstructions from the river between mouth and Granby so as to give a 3-f. depth at low water, **87**, 1094, 1095.
**1887–88.** 73 logs and stumps and 5 cords of small snags removed from the river channel, **88**, 944.
**1888–89.** 13 logs and stumps removed from the channel, **89**, 1193.
**1889–90.** 1,110 trees, logs, and snags removed from the channel; 450 trees and 8 cords brush cut from the banks, **90**, 1226.

## CONGAREE RIVER, S. C.—Continued.

**1890–91.** 1,374 snags and stumps cleared from the channel, and 913 trees and 58 cords of brush removed from the banks, **91**, 1466.

**1891–92.** 195 snags and logs and 11 cords of small snags cleared from the channel, **92**, 1218.

**1893–94.** About 700 stumps and other obstructions removed from the channel and banks, **94**, 1093.

**1895–96.** About 1,300 snags and other obstructions removed, **96**, 1181.

**1896–97.** About 150 snags and other obstructions removed, **97**, 1470.

**1897–98.** Over 1,100 snags and other obstructions removed, **98**, 1280.

**Physical characteristics.**

Description of, **85**, 1140, 1144; **94**, 1096.

**Projects.**

By Capt. Bixby, 1884, 4-f. navigation from its mouth to Granby Landing, 47 miles, by the removal of snags, logs, rocks, and slight shoals, and properly protecting caving banks; estimate, $30,000, **85**, 1144.

In 1887 the project was modified by providing for the clearing of obstructions to the natural depth of the river above Grandby; estimate, $54,500, **87**, 1093; **91**, 1465; **92**, 1217.

In response to a resolution passed by Congress, 1893, Capt. Abbot, 1894, estimated that the cost of constructing a lock and dam just below Columbia, S. C., would be $250,000, **94**, 1095; **96**, 1186.

Maj. Ruffner, 1897–98, estimated that $6,000 would be required annually for maintenance, **98**, 1280.

**Surveys.**

Ordered by act of July 5, 1884, made under the direction of Capt. Bixby, 1885, **85**, 1140, 1143.

Survey from Granby to the foot of Gervais street made, 1892–93, under the direction of Capt. Abbot, **93**, 1492.

MAPS. **87**, 1094; **89**, 1194.

## CONGAREE RIVER, S. C., GERVAIS STREET BRIDGE, COLUMBIA, TO GRANBY.

**Appropriations.**

1899, $50,000, **99**, 1542.
1900, 100,000, **1900**, 1865.

Total, 150,000

**Contracts.**

**1900.** G. W. Waring, constructing lock keeper's house and other necessary buildings, $3,935, **1900**, 1866.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99**, 252; **1900**, 286.

ENGINEERS IN CHARGE:

Maj. E. H. Ruffner, 1899. Report, **99**, 1542.

Capt. J. C. Sanford, 1900–. Report, **1900**, 1864.

ASSISTANT. W. A. Leland. Report, **1900**, 1866.

**Legal proceedings.**

Condemnation proceedings instituted, 1899, for most of the land required, **99**, 1542. Necessary land obtained, **1900**, 1865.

**Projects.**

By Capt. Abbot, 1894, for securing a depth in the 2 miles of the river just below Columbia, S. C., equal to that already provided for the rest of the stream, by constructing a movable lock and dam, estimate, $250,000, **94**, 1095; **96**, 1186; **99**, 1542.

**Survey.**

Survey made, 1900, under direction of Capt. J. C. Sanford, **1900**, 1865.

## CONNEAUT CREEK. (See *Elk Creek, Ohio.*)

## CONNEAUT HARBOR, OHIO.[a]

**Appropriations.**

1829, $7,500.00, **66**, iii, 32.
1830, 6,135.65, **66**, iii, 32.
1831, 6,370.00, **66**, iii, 32.
1832, 7,800.00, **66**, iii, 32.
1836, 2,500.00, **66**, iii, 32.
1837, 5,000.00, **66**, iii, 32.
1838, 8,000.00, **66**, iii, 32.
1844, 5,000.00, **66**, iii, 32.
1852, 10,000.00, **66**, iii, 32.
1866,[b] 20,513.74, **66**, iii, 4, iv, 7; **67**, 139.
1867, 10,000.00, **67**, 139.
1869,[c] 8,910.00, **69**, 22; **70**, 49. Allotment.
1870, 6,000.00, **70**, 49, 181; **71**, 47.
1873, 400.00, **73**, 342.
1874, 1,500.00, **74**, 51; **75**, 315.
1875, 1,000.00, **75**, 56, 315.
1880, 6,000.00, **80**, 2172.
1892, 40,000.00, **93**, 3092.
1894, 40,000.00, **95**, 3120.
1896, 40,000.00, **96**, 2969.
1899, 100,000.00, **99**, 3073.

Total, 332,629.39

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[a] Conneaut and Elk creeks to Ere Harbor, Pa., canal. Survey—Report, May 12, 1832. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Error of $7,000 in appropriation of 1866 as printed in list of appropriations, **79**, 1702.

[c] Called, $9,000, **69**, 38 141, 142; **70**, 181.

## CONNEAUT HARBOR, OHIO—Continued.

**Commerce.**

Description of, **95**, 3120; **96**, 2968, **97**, 3091.

Shipments of coal and ore, large, **94**, 2425; **95**, 3120.

The freight tonnage in three years rose from nothing to 500,000 tons, **96**, 2968; the average annual increase exceeding 100,000 tons, **98**, 2686.

Developing very rapidly, **99**, 3072.

**Contracts.**

**1866.** Kenneth & McKenzie, materials and labor, **66**, iv, 8, 74; **67**, 139. J. Loveday, iron, **66**, iv, 8, 74; **67**, 139.

**1871.** H. W. Smith, materials and labor, **71**, 196; **72**, 233.

**1881.** J. W. Dennis, pile construction, **81**, 2329.

**1893.** L. P. & J. A. Smith, pier construction, $35,906.40, **93**, 3093.

**1895.** C. M. Carrier, hemlock timber, $10 per M f.; E. D. Weimer, white-pine timber, $21.37 per M f.; Wm. Pattison, ironwork, $2,447.86; Kelley Island Lime & Transport Co., stone, $5.55 per cord, **95**, 3121.

**1897.** E. F. Loud, hemlock timber, $10.98 per M f.; C. H. Carleton, white-pine timber, $19.40 per M f., **97**, 3092. T. C. Gill & Co., ironwork, $1,871.65; Breckinridge & Uber, riprap stone, 95 cents per ton ($2,375); Kelley Island Lime & Transport Co., filling stone, $1.18 per ton ($7,788), **97**, 3093.

**1899.** J. B. Donnelly, breakwater construction (dredging, timber, stone, ironwork), $23,404.20, **99**, 3073. E. J. Hingston, dredging, 18 cents per c. y. (circular letter) **99**, 3072.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 4, iii, 32, iv, 7; **67**, 30; **68**, 42; **69**, 22, 38; **70**, 49; **71**, 47; **72**, 44; **73**, 44; **74**, 51; **75**, 56; **76**, 108; **77**, 115; **78**, 130; **79**, 173; **80**, 228; **81**, 312; **82**, 307; **83**, 315; **84**, 319; **85**, 343; **86**, 338; **87**, 303; **88**, 276; **89**, 328; **91**, 373; **92**, 352; **93**, 413; **94**, 377; **95**, 412; **96**, 367; **97**, 461; **98**, 451; **99**, 534; **1900**, 601.

ENGINEERS IN CHARGE:

Capt. Howard Stansbury, 1856, S. Doc. 42, 35th Cong., 1st sess.

Lt. Col. J. D. Graham, 1857. S. Doc. 42, 35th Cong., 1st sess.

Col. T. J. Cram, 1866–68. Reports, **66**, iv, 6–10, 69, 72–75; **67**, 139, 148, 230–233.

Maj. W. McFarland, 1868–71. Report, **68**, 160; **69**, 141; **70**, 180.

Capt. G. L. Gillespie, 1871–73. **71**, 89. Reports, **71**, 196; **72**, 233.

Maj. F. Harwood, 1873–74. **73**, 42. Reports, **73**, 342; **74**, 224.

Lt. Col. C. E. Blunt, 1874–78. **74**, 215. Reports, **75**, 292, 315; **76**, ii, 515, 563; **77**, 963, 968.

Maj. W. McFarland, 1878. Report, **78**, 1264.

Maj. J. M. Wilson, 1878–82. Reports, **79**, 1705; **80**, 2166; **81**, 2328; **82**, 2412.

Capt. M. B. Adams, 1883–84. Report, **83**, 1920.

Capt. E. Maguire, 1884–85. Report, **84**, 2118.

Maj. L. C. Overman, 1885–92. Reports, **85**, 2245; **86**, 1873; **87**, 2332; **88**, 2015; **89**, 2340.

Lt. Col. J. A. Smith, 1892–. Reports, **92**, 2515; **93**, 3089; **94**, 2423; **95**, 3117; **96**, 2965; (Col.) **97**, 3090; **98**, 2683; **99**, 3071; **1900**, 4091.

ASSISTANTS:

Maj. F. U. Farquhar, submitted estimate, **66**, iv, 7.

Capt. M. B. Adams, **75**, 53, 292.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Col. Graham, extension of piers 600 f. to 12 f. of water, repairs, and dredging, $31,559.60, S. Doc. 42, 35th Cong., 1st sess.

By Maj. Farquhar, under direction of Col. Cram, repairs and extension of west pier and dredging 115 f. wide by 12 f. deep, $31,112, **66**, iv, 7, 73.

By Col. Cram, additional, to complete the work, $10,638, **67**, 140, 148.

By Maj. McFarland, repairs of injury caused by freshet, $9,000, **68**, 161; to complete the work, $6,000, **69**, 142.

By Maj. Harwood, permanent completion, $3,500, **73**, 342; $1,000, **74**, 224.

By Maj. Wilson, completion of existing project, $26,092, **79**, 173, 1706.

**Operations.**

**1856.** 890 f. of pier rebuilt on old foundations; 120 f. of pier repaired, S. Doc. 42, 35th Cong., 1st sess.

**1867–68.** Repairs to piers continued and material collected for extension of west pier, **68**, 160.

**1868–69.** East pier repaired and extension to west pier completed, **69**, 141.

**1869–70.** Repairs and extension to pier, **70**, 180.

**1870–71.** Repairs of west pier head completed, **71**, 196.

**1871–72.** Extension of east pier 90 f., **72**, 44.

**1873–74.** West pier head riprapped, **74**, 224.

**1874–77.** Slight repairs of piers, **75**, 315; **76**, ii, 563; **77**, 968.

**1881–82.** 473 l. f. pile protection finished, **82**, 2412.

**1893–94.** Extension of old west pier completed, **94**, 2423.

**1894–95.** A device to throw large waves from the end of the pier erected and pier construction in progress, **95**, 3118.

**1895–96.** Miscellaneous dredging

## CONNEAUT HARBOR, OHIO—Continued.

done, repairs made to outer end of new west pier, and in connection with preceding year 600 l. f. of east breakwater constructed, **96**, 2965.

**1896–97.** Breakwater construction commenced, **97**, 3090.

**1897–98.** 282 l. f. west breakwater completed in connection with previous year, 15,776 c. y. dredged, and repairs made to east pier, **98**, 2685, 2686.

**1898–99.** Lines of breakwaters laid out on heavy ice formation; 9,000 c. y. dredged, **99**, 3071.

**1899–1900.** 16,500 c. y. dredged; preparations made for breakwater construction, **1900**, 4092.

**Physical characteristics.**

Description of, **66**, iv, 6; **67**, 139; **93**, 3090; **96**, 2970, 2971.

Beach at inner end of west pier washed away in a remarkable way by the sea, **99**, 3072.

Action of breakwaters at the harbor on sand movement, **1900**, 4092; bar formation, **1900**, 4092.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Col. Graham, repairs, dredging, and extension of piers to 12 f. of water, S. Doc. 42, 35th Cong., 1st sess.

By Col. Cram, pile pier proposed, description of, **66**, iv, 69.

Maj. Overman reported, 1888, that unless the facilities of the harbor were increased further improvement would be unnecessary, **88**, 2015.

In 1889 Maj. Overman estimated that the repair and removal of piers and revetment and dredging to 16 f. depth through harbor entrance would cost $115,000, **89**, 2341.

In 1891 Maj. Overman recommended the construction of new piers and dredging between them to a depth of 17 f., each pier to be about 2,000 f. long and to extend to the 17 f. curve in the lake; estimate, $418,140, **92**, 2519.

**Private work.**

Description of work done by the Pittsburg, Shenango and Lake Erie R. R. Co. for the improvement of the harbor, **93**, 3091; **94**, 2425; **95**, 3120; **97**, 3090; **99**, 3072.

**Projects.** (See *Estimates* and *Plans.*)

Original, **75**, 315; **76**, ii, 563; **77**, 968.

By Capt. Maurice, 1829, closing existing channel through sand bar at mouth of river by means of parallel piers of crib work; estimate, $20,001.65, **80**, 2166. Project completed in 1835, **80**, 2167.

By Col. Cram, 1866, repair of existing pier work, prolongation of west pier 350 f.; and dredging channel 115 f. wide and 12 f. deep; estimate, $31,112, **66**, iv, 7; **67**, 139; **80**, 2169. Project completed in 1872, **80**, 2170.

By Maj. Wilson, for east pier, 480 l. f. of pier and 381 l. f. of superstructure; west pier, 791 l. f. of superstructure, **79**, 1706.

History of early projects, **79**, 1705.

By Maj. Wilson, 1880, restoration of pier and construction of pile work; estimate, $35,090, **80**, 2171; **86**, 1873; **87**, 2332.

By Lt. Col. Smith, 1892–93, for widening and deepening the existing old channel to a depth of 17 f. by the extension of east and west piers each 480 f.; estimate, $500,000, **93**, 3090.

By Lt. Col. Smith, 1892–93, expending available funds in extending the west pier into the lake as far as possible from the old west pier with the usual type of crib and superstructure filled with stone and resting upon a foundation of riprap stone, **93**, 3090.

By Lt. Col. Smith, 1896, constructing 480 f. of pier on the west side, for extending east pier 450 f. and west pier 150 f., for two breakwaters—one on the west side 1,250 f. long, the one on the east 1,050 f. long—and for the removal of rock and other material at an estimated cost of $530,000, to obtain a depth of 25.5 f. in an entrance of 350 f. width and a depth of 20 f. or more in the protected area, **96**, 2971.

By Col. Smith, 1897, expending $35,000 of the appropriation of 1896 on the construction of the breakwaters, and for reserving $5,000 for maintenance and contingencies, **97**, 3091.

$8,000 was reserved from appropriation of 1899 for maintenance of piers and channel depths, **99**, 3072.

Method of constructing breakwaters to avoid extensive repairs, **1900**, 4092.

**Surveys.**

By Capt. Stansbury, in 1856, S. Doc. 42, 35th Cong., 1st sess.

Under direction of Maj. Wilson, in 1878–79, **79**, 1705.

Examination made in 1879, **80**, 2170.

Examination for deepening and widening the channel ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Overman, **89**, 2340.

Survey of Conneaut Harbor, made, 1891, under direction of Lt. Col. Smith, **92**, 2517.

Complete hydrographic survey of the harbor and the lake inside the 25-f. contour made in 1894 under direction of Lt. Col. Smith, **96**, 2966.

Examination of the channel made, 1898, by Col. Smith, **98**, 2685.

Minor surveys, **99**, 3071; **1900**, 4093.

MAPS.

Of northern and northwestern lakes, showing location of this harbor, **66**; **81**, 2330; **93**, 3090; **95**, 3120; **96**, 2972.

## CONNECTICUT RIVER.[a] (See *Fifteen-Mile Falls, N. H.*)

| Part. | Appropriations. |
|---|---|
| A.—Connecticut River | $327,804.57 |
| B.—Below Hartford, Conn | 257,836.12 |
| C.—Above Hartford, Conn | 15,000.00 |
| Total | 600,640.69 |

### Part A.—Connecticut River.[b]

**Appropriations.**

| | | |
|---|---|---|
| 1829, | $130.00, | act Mar. 2. |
| 1836, | [c]20,000.00, | **73**, 990. |
| 1843, | [c]3,471.57, | Treas. Doc. No. 373, 1882. |
| 1870, | 20,000.00,<br>[d]20,000.00, | **70**, 74, 447; **71**, 84, 756; **73**, 1003. |
| 1871, | 35,000.00,<br>[d]20,000.00, | **71**, 85, 756, 762. |
| 1872, | 40,000.00,<br>[d]25,000.00, | **72**, 82, 835. |
| 1873, | 20,000.00,<br>[d]20,000.00, | **73**, 90, 91. |
| 1874, | 20,000.00, | **74**, 101, ii, 249. |
| 1875, | 20,000.00, | **75**, 110, ii, 300. |
| 1876, | 20,000.00, | **76**, 51, 212; **77**, 45, 205. |
| 1878, | 30,000.00,<br>4,203.00, | **78**, 50, 247.<br>**1900**, 1330. |
| 1879, | 10,000.00, | **79**, 56, 316. |
| Total, | 327,804.57 | |

**Contracts.**

**1870.** Albany Dredging Co., dredging; E. R. Seward, pile work, **70**, 448; **71**, 756.

**1871.** M. F. Brainard, dredging; W. D. Daisley,[e] removal of rock; C. McClellan & Son, building wing dams, **71**, 760.

**1872.** M. F. Brainard, dredging; G. W. Townsend, removing wreck, **72**, 835.

**1873.** W. E. Redding, granite, $2.23 per ton, **73**, 985.

**1874.** F. H. Smith, granite, $1.93 per ton; —— Goodspeed, dredging, $90 per day, **75**, ii, 297.

**1875.** —— Goodspeed, dredging, $75 per day; F. H. Smith, granite, $1.59 per ton, **75**, ii, 298.

**1877.** G. W. Townsend, removal of wreck, **77**, 205.

**1878.** Sidney Edsall, building wing dams, **78**, 248; E. N. & A. J. Beardsley, dredging, **79**, 317; F. H. Smith, granite, 76 cents per ton, **79**, 318.

**Engineers.**

CHIEF OF ENGINEERS:

Suggesting the use of Long's scraper, **68**, 782.

Reports, **67**, 18, 44; **68**, 66; **69**, 57; **70**, 74; **71**, 84, 85; **72**, 82; **73**, 90; **74**, 100, 101; **75**, 109, 110; **76**, 50, 51; **77**, 45; **78**, 49, 50, 249; **79**, 55, 56.

ENGINEERS IN CHARGE:

Capt. W. H. Swift, 1836–37, **68**, 782; **73**, 993, 996.

Maj. D. C. Houston, 1867–70. Reports, **67**, 448; **68**, 754, 782; **69**, 409.

Maj. G. K. Warren, 1870–83. Reports, **70**, 446; **71**, 756, 760, 762; **72**, 830, 835, 836; **73**, 984, 986, 1003; **74**, ii, 248, 249; **75**, ii, 297, 300; **76**, 212, 213; **77**, 204, 206; **78**, 246, 247; **79**, 316, 319.

ASSISTANT. T. G. Ellis, **67**, 450.

Survey, Hartford to mouth, **68**, 756; river above Hartford, **71**, 763.

Survey of Enfield Rapids and plan for improvement, **72**, 840.

Survey and plan for improvement of Saybrook Bar, **73**, 990.

Canal from Hartford to Warehouse Point, **73**, 1005.

Survey from Hartford to Holyoke, **74**, ii, 250; **75**, ii, 303; **78**, 264.

Resistance of cords and floats, **76**, 213; **78**, 380.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Houston, channel Hartford to mouth, 8 f. in depth, $70,000, and $10,000 annually for maintenance, **68**, 67, 750, 756; **69**, 58, 409; **70**, 74. Revised for 9-f. channel over Saybrook Bar, $17,500; for 12-f. channel over Saybrook Bar, $62,000, **68**, 784.

By T. G. Ellis, aggregate for existing needs, $64,310, **68**, 779. Jetties, dikes, and dredging at Saybrook Bar, $336,610, **73**, 989, 1000. Five wing dams and locks at Enfield Rapids, $850,000, **71**, 762, 768. Various plans submitted, **72**, 857. Canal from Enfield Dam to Hartford, $2,306,345, **73**, 1011.

By Maj. Warren, jetty and dredging, Saybrook Bar, $116,410, **73**, 989. (1877)

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[a] Burnet to Lake Connecticut: Survey—Report Dec. 1, 1825. Canal from Dodges Falls to Hartford: Survey—Report Jan. 13, 1831, estimate, $3,311,149. At Saybrook Bar: Survey—Report Jan. 31, 1837, estimate, $54,380.50. Canal to Memphremagog Lake: Survey—Report Dec. 1, 1825: H. Doc. No. 482, 55th Cong., 2d sess.

[b] Including improvement below Hartford, at Saybrook Bar, at mouth of Salmon River, and above Hartford.

[c] Saybrook Harbor.

[d] Above Hartford.

[e] Failed to enter into contract, **72**, 831.

## CONNECTICUT RIVER—Continued.

### Part A.—Connecticut River—Continued.

To complete jetties, $45,000, **77**, 45, 206. (1878) To complete project, $30,000, **78**, 50, 247. Enfield Falls, $870,000, **72**, 835, 838. Thorough improvement, Hartford to Holyoke, $3,000,000, **72**, 836. Canal, Enfield Dam to Hartford, $2,306,345, **73**, 1011. Completion of proposed project above Hartford, $835,801, **78**, 50, 248; **79**, 56, 320.

**Expenditures.** (See *Private work.*)
Union Co., 1800 to 1835, $44,271, **68**, 767.
Steamboat company, $34,000, **68**, 768.
City, $12,000, **68**, 768.

**Operations.**
**1836–37.** Believed to have been dredging at Saybrook Bar, **73**, 990, 996. Former referred to, **67**, 450; **68**, 67, 767, 768.

BELOW HARTFORD:
**1870–71.** Dredging river bars and piling, **71**, 84. 63,541 c. y. removed, **71**, 756.
**1871–72.** 8 f. channel at lowest water obtained by dredging, **72**, 82, 833. 114,063 c. y. dredged from various bars, 25 c. y. solid rock removed, and 547 piles driven, **72**, 831, 834.
**1872–73.** West jetty at Saybrook Bar in progress, 19,289 c. y. dredged from river bars, **73**, 985; and a wreck removed, **73**, 989.
**1873–74.** River bars were dredged, giving channel 50 to 70 f. by 9½ f.; west jetty at Saybrook Bar built out 1,600 f., **74**, 100, ii, 248.
**1874–75.** Dredging on river bars continued; west jetty completed, total length 2,432 f.; east jetty commenced, 247 f. built, **75**, ii, 297, 298.
**1875–76.** 14,820 c. y. dredged from river bars; east jetty lengthened to 1,144 f., **76**, 212.
**1876–77.** Dredging and removal of a wreck in progress; repairs to west jetty made, **77**, 45, 205.
**1877–78.** River bars dredged; wreck removed, **78**, 49, 246.
**1878–79.** River bars and Salmon River dredged; east jetty extended 220 f., **79**, 55, 56, 316.

ABOVE HARTFORD:
History of operations, **73**, 1003, 1006; **78**, 247; **79**, 319.
**1870–71.** Building wing dams, **71**, 84; in progress, **71**, 760.
**1871–72.** Wing dams built on Scantic River Bar, Strongs Island Bar, and Farrington Bar, **72**, 82, 835.
**1872–73.** Dredging at Barbers Landing Bar, **73**, 1005.
**1873–74.** Dredging at Barbers Landing Bar, **74**, 101, ii, 249.

**Physical characteristics.**
Described, **67**, 450.
General discussion, **68**, 759; **71**, 765; **72**, 839, 845.
Saybrook Bar, **73**, 988, 993.
Hartford to Enfield, **73**, 1007.
Hartford to Holyoke, **74**, ii, 251; **75**, ii, 313, 369; **78**, 267, 391.

**Plans.** (See *Estimates* and *Projects.*)
By T. G. Ellis, wing dams, **71**, 765. Canal around Enfield Falls, various plans proposed, **72**, 837, 847.
By T. G. Ellis, dredging and piling, **68**, 778. Piers and dredging at Saybrook Bar, details, **73**, 997.

**Private** (city and corporate) **work.** (See also *Expenditures.*)
Summary of, Union Co., 1800–1835, **68**, 766.
Dredging by the steamboat company and city, **68**, 768; **70**, 447.
Summary of, Connecticut River Co., **72**, 843.
Dredging and scraping by the steamboat company at Saybrook Bar, **73**, 996.
Dredging river bars by Hartford & New York Steamboat Co., 1876, **77**, 45, 204.

**Projects.** (See *Plans.*)
By Maj. Warren, wing dams at five places, Hartford to Enfield Rapids, **71**, 84, 757.
By Maj. Houston, channel 200 f. by 8 f., below Hartford, by dredging and scraping the bars, **68**, 66, 750, 755, 776; **69**, 57, 409; **70**, 447.
By Maj. Warren, jetties and dredging, Saybrook Bar, **73**, 985.

**Secretary of War.**
Recommends publication in full of Maj. Warren's surveys and examinations between Hartford and Holyoke, **78**, 248.

**Surveys.**

ABOVE HARTFORD:
**1871–75.** By T. G. Ellis, under direction of Maj. Warren. Reports, **72**, 836, 840; **73**, 1003, 1005; **74**, ii, 250; **75**, ii, 300, 303; **78**, 249, 264.

BELOW HARTFORD:
**1720.** J. Copp, **73**, 992.
**1770.** Capt. A. Parker, **73**, 993.
**1836.** J. W. Adams, under direction of Capt. Smith, **73**, 993.
**1835–36–45–49–50.** By Coast Survey, **73**, 993.

**CONNECTICUT RIVER**—Continued.

**Part A.—Connecticut River**—Continued.

**1867.** By T. G. Ellis, under direction of Maj. Houston, **67**, 18, 44, 450. Reports, **68**, 754, 756.

**1872.** By T. G. Ellis, under direction of Maj. Warren. Reports, **73**, 986, 990.

**1875.** By T. G. Ellis, under direction of Maj. Warren. Report, **76**, 212.

**1879.** By T. G. Ellis, under direction of Lt. Col. Warren, **79**, 316.

MAPS:

Saybrook Bar, 1873, **73**, 987.

Surveys between Hartford and Holyoke, 1871–1875, by T. G. Ellis, Plates Nos. I to XVI, inclusive, **78**, 392.

Survey, Saybrook Bar, **79**, 318.

**Part B.—Connecticut River, below Hartford, Conn.** (See *Part A.*)

**Appropriations.**

1880, $10,000.00, **80**, 398.
1881, 30,000.00, **81**, 578.
1882, 45,000.00, **82**, 566.
1884, 35,000.00, **84**, 642.
1884, 6,479.32, act July 7.
1886, 26,250.00, **86**, 629.
1888, 10,000.00, **88**, 535.
1888, 2,606.80, act Aug. 19.
1890, 12,500.00, **90**, 613.
1892, 20,000.00, **92**, 663.
1894, 20,000.00, **95**, 773.
1896, 20,000.00, **96**, 693.
1899, 20,000.00, **99**, 1159.

Total, 257,836.12

**Commerce.**

Business influenced by proposed improvement, **80**, 399.

**Contracts.**

**1879.** Hartford & New York Steamboat Co., dredging, 16⅝ cents per c. y., **80**, 397.

**1880.** J. Beattie, riprap granite, $1.05 per ton, **81**, 575. McDermott & Daly, dredging, 15¾ cents per c. y., **81**, 575.

**1881.** E. H. Williams, dredging, 13 cents per c. y., **81**, 576. E. H. Williams, wing-dam construction, $1.60 per c. y., **81**, 577. E. H. Williams, riprap granite, $1.29 per ton, **81**, 577. J. McDermott, dredging, 14⅝ cents per c. y., **82**, 565.

**1884.** H. N. & A. J. Beardsley, dredging, 15 cents per c. y., **85**, 636. J. Beattie, jetty construction, $1.16 per ton, of stone, **85**, 636.

**1886.** C. H. Edwards, dike construction, Hartford, **87**, 595. J. V. Luce, dike construction at Saybrook, **87**, 595.

**1887.** Pidgeon Dredging Co., dredging, 11 7/10 cents per c. y., **87**, 595.

**1889.** J. H. Fenner, hire of dredging plant, $8.45 per hour, **89**, 668.

**1891.** Hartford Dredging Co., hire of dredging plant, $8.20 per hour, **91**, 756.

**1892.** C. C. Goodrich, dredging, 12 cents per c. y., **93**, 911.

**1895.** Newburg Dredging Co., dredging, 10½ cents per c. y., s. m. ($9,000), **95**, 774.

**1896.** J. P. Randerson, dredging, 9⅞ cents per c. y., s. m. ($9,000), **96**, 693.

**1897.** Hartford Dredging Co., dredging, 9 cents per c. y. ($9,000), **97**, 950.

**1898.** Hartford Dredging Co., dredging, 7.8 cents per c. y. ($7,800), **98**, 952.

**1899.** J. P. Randerson, dredging, 9⅞ cents per c. y. ($8,999.98), **99**, 1160.

**1900.** Hartford Dredging Co., dredging, 12 cents per c. y. ($7,980), **1900**, 1330.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 76; **81**, 88; **82**, 88; **83**, 87; **84**, 93; **85**, 80; **86**, 82; **87**, 45; **88**, 46; **89**, 58; **90**, 52; **91**, 65; **92**, 69; **93**, 74; **94**, 66; **95**, 75; **96**, 73; **97**, 86; **98**, 91; **99**, 104; **1900**, 119.

ENGINEERS IN CHARGE:

Lt. Col. G. K. Warren, 1870–83. Reports, **80**, 396, 398; **81**, 575; **82**, 564.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 508; **84**, 640; **85**, 633.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 625; **87**, 590; **88**, 530, 536; **89**, 663; **90**, 608, 614, 615; **91**, 750; **92**, 658.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 908; **94**, 632; (Col.), **95**, 768.

Maj. H. M. Adams, 1896. Report, **96**, 689.

Maj. S. S. Leach, 1897–. Reports, **97**, 948; **98**, 949; **99**, 1158, **1900**, 1328.

ASSISTANT. T. G. Ellis. Report, **80**, 400.

**Operations.**

**1879–80.** 8,136 tons stone placed in 765 l. f. of jetty, 34,692 c. y. dredged, **80**, 397.

**1880–81.** 26,062 c. y. dredged, 6,184 tons stone placed in east jetty, **81**, 576.

**1881–82.** 9,017 c. y. dredged, 7,109 c. y. stone placed in dam, 4,984 tons granite placed in jetties, **82**, 565,566.

**1882–83.** 31,117 c. y. dredged, 10,307 tons stone placed in wing dam, **83**, 509.

**1883–84.** 61,342 c. y. dredged, **84**, 641.

**1884–85.** 148,366 c. y. dredged,

## CONNECTICUT RIVER—Continued.

### Part B.—Connecticut River, below Hartford, Conn.—Continued.

8,840 tons stone placed in jetty extension, **85**, 636.

**1885–86.** 1,582 tons stone placed in jetty extension, 24,054 c. y. dredged, **86**, 627, 628.

**1886–87.** 51,261 c. y. dredged from shore areas, 2,346 tons stone placed in Hartford dike, 6,829 tons of stone placed in Saybrook jetties, **87**, 592.

**1887–88.** 1,080 tons granite delivered in west jetty; 46,604 c. y. dredged, **88**, 533.

**1888–89.** 98,511 c. y. dredged, **89**, 666.

**1889–90.** 63,441 c. y. dredged, **90**, 611.

**1890–91.** 37,763 c. y. dredged from the bars, **91**, 754.

**1891–92.** 58,058 c. y. dredged, **92**, 661.

**1892–93.** 42,424 c. y. dredged, **93**, 912.

**1893–94.** 68,147 c. y. dredged, **94**, 635.

**1894–95.** 60,425 c. y. dredged, **95**, 771.

**1895–96.** 65,315 c. y. dredged, **96**, 691.

**1896–97.** 73,370 c. y. dredged, **97**, 949.

**1897–98.** 110,503 c. y. dredged, **98**, 951.

**1898–1900.** 99,883 c. y. dredged, **99**, 1158; **1900**, 1329.

**Physical characteristics.**

Description of, **80**, 401; **93**, 908.

Discharge and height, Hartford, 1878, **80**, 408.

Height of freshets above low water, **80**, 403.

Slope of river, **80**, 411.

Table of borings, Hartford to Rocky Hill, **80**, 420.

Description of, rise and fall of tides, **88**, 530.

**Projects.**

The project of 1868 proposed dredging channels 8 f. deep at low water and 100 f. wide at Hartford, Clay Banks, Pratts Ferry, Glastonbury, and Pistol Point, and a channel 200 f. wide and 8½ f. deep at Saybrook bar; shore protection at Hartford and Weathersfield, and the removal of Chester Rock, **68**, 66, 750, 776; **69**, 409; **70**, 447; **87**, 591.

In 1873 jetties were proposed for the improvement of Saybrook bar, with dredging to form a channel 9 f. deep and 400 f. wide, **73**, 985; **87**, 591.

By Lt. Col. Warren, 1879, for channel 200 f. wide and 9 f. deep, Hartford to Long Island Sound, by mattress protection of banks; rectification of banks at Clay Banks and Glastonbury bar; wing dams at Hartford bar, Pratts Ferry bar, Press Barn bar, Glastonbury bar, and Dividend bar; estimate, $330,000, **80**, 417, 418, 419, 420.

By Col. Houston, 1887, completion of the jetties at the mouth of the river to a height of 5 f. above high water and a top width of 6 f., widening the channel between the jetties to 400 f., with a depth of 12 f. at m. l. w., and annual dredging to maintain the channel from Hartford to Long Island Sound; estimate, $90,000, **88**, 532.

By Col. Houston, 1889, raising the dike at Hartford to 15 feet above low water; estimate, $50,000. Thus increasing the total cost for completion of the project to $140,000, **89**, 614, 615; **92**, 659.

**Surveys.**

Examination of channel, 1880, **80**, 397.

Survey between Hartford and Rocky Hill, made, 1879, under direction of Lt. Col. Warren, **80**, 398.

Maps, **83**, 510; **85**, 636.

### Part C.—Connecticut River, above Hartford, Conn. (See *Part A*.)

**Appropriation.**

1880, $15,000, **80**, 396.

**Commerce.**

Probable, description of, **98**, 981.

Important, Hartford to Holyoke, **98**, 988.

**Contracts.**

**1880.** H. & N. Y. Transportation Co., building wing dams, $1.85 per c. y., **80**, 395.

**1886.** C. G. Goodrich, repair of dikes, **97**, 589.

**Engineers.**

Chief of Engineers. Reports, **80**, 75; **81**, 86; **82**, 87; **83**, 87; **84**, 93; **85**, 80; **86**, 81; **87**, 44; **88**, 46; **89**, 57; **90**, 52; **91**, 64; **92**, 68; **93**, 73; **94**, 65; **95**, 75; **98**, 111.

Engineers in Charge:

Lt. Col. G. K. Warren, 1870–83. Reports, **80**, 394; **81**, 565, 566; **82**, 564.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 507; **84**, 639; **85**, 632.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 623; **87**, 587; (Col.) **88**, 527; **89**, 660; **90**, 606; **91**, 748; **92**, 656.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 907; **94**, 630; (Col.) **95**, 766.

Maj. S. S. Leach, 1898——. Report, **98**, 976.

Assistant. T. G. Ellis. Report, **81**, 568.

## CONNECTICUT RIVER—Continued.

### Part C.—Connecticut River, above Hartford, Conn.—Continued.

**Obstructions.**

At Holyoke navigation interrupted by a dam for the development of power which has no provision for the passage of vessels, **98**, 977.

Description of dam, etc., at Enfield, built by the Connecticut Power Co., **98**, 978.

List of 13 bridges crossing the river from Hartford to Holyoke, **98**, 981.

**Operations.**

**1880–81.** 820 l. f. of upper dam and 643 l. f. of lower dam finished, **81**, 565.

**1881–82.** 180 l. f. of upper dam and 185 l. f. of lower dam completed, **82**, 564.

**1884–85.** 1,029 c. y. stone placed in dike, **85**, 633.

**1886-87.** Repair of wing dams at mouth of Farmington River and at Barbers Landing, **87**, 588.

**Physical characteristics.**

Description of, above Hartford, **81**, 569; **88**, 528.

Description of, Hartford to Holyoke, **98**, 976.

The part of the river designated in the act of June 3, 1896 (*Surveys*), 34 miles long, consists of two stretches of diverse character. From Holyoke to Enfield dam, 18 miles, the bed is erosible, while from the dam to the foot of the rapids it is mostly nonerosible, **98**, 977.

Table showing duration of certain stages of the river above Hartford for 7 years, 1871–77, **98**, 980.

**Plans.** (See *Projects.*)

By Lt. Col. Warren, 1880, canal around Enfield Falls, on east bank of river, extending down to mouth of Hockanum River, opposite Hartford; estimate, $1,322,805, **81**, 566; **87**, 588.

**Projects.** (See *Plans.*)

By Maj. Warren, 1871, increased depth to channel with wing dams at five places between Hartford and Enfield Rapids, and by dredging; estimate, $850,000, **71**, 84, 757. No general project adopted, **87**, 588; **88**, 528; **91**, 749; **92**, 657.

In 1897 Maj. Leach estimated it would cost $1,825,000 or $2,075,000 to improve the river between Hartford and Holyoke with locks and dams, etc., **98**, 988.

**Surveys.**

Of Farmington River Bar, 1879, to ascertain condition of channel, **80**, 394.

Survey, Holyoke, Mass., to foot of Enfield Rapids ordered by act of June 3, 1896, made in 1897 by Maj. Leach (report favorable to improvement of the river between Hartford and Holyoke), **98**, 976.

## CONNECTICUT RIVER (Bellows Falls, Vt., to Plattsburg, N. H.).

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 99.

ENGINEER IN CHARGE. Maj. J. W. Barlow. Report, **84**, 659.

**Physical characteristics.**

River described, **84**, 659.

**Plans.**

In 1882 Maj. Barlow reported improvement not worthy to be made by United States, **84**, 659.

## CONSTABLE HOOK (See *Hudson River*).

## CONTENTNIA CREEK, N. C.

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $10,000, | **81**, 1010. |
| 1882, | 10,000, | **82**, 1092. |
| 1884, | 5,000, | **84**, 1042. |
| 1886, | 15,000, | **86**, 975. |
| 1888, | 5,000, | **88**, 860. |
| 1890, | 7,000, | **90**, 1117. |
| 1892, | 7,000, | **92**, 1124. |
| 1894, | 10,000, | **95**, 1315. |
| 1899, | 2,000, | **99**, 1492. |
| Total, | 71,000 | |

**Commerce.**

Important, **81**, 1012; **83**, 855.

Development of commerce due to improvement; reduction in transportation and insurance rates, **88**, 862; **90**, 1118.

In 1893 it did not appear to be in any way useful to commerce to continue the improvement of the creek above Snowhill, 31 miles from the mouth, **93**, 1385.

The channel in good, navigable condition for the boats plying on the creek in 1894, **94**, 1023.

Description of, **1900**, 1801.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 164; **82**, 159; **83**, 166; **84**, 172; **85**, 164; **86**, 160; **87**, 124; **88**, 117; **89**, 137; **90**, 123; **91**, 158; **92**, 158; **93**, 172; **94**, 157; **95**, 180; **96**, 162; **97**, 202; **98**, 204; **99**, 235; **1900**, 268.

ENGINEERS IN CHARGE:

Capt. C. B. Phillips. Report, **81**, 1010.

## CONTENTNIA CREEK, N. C.—Continued.

Capt. J. Mercur, 1881–84. Reports, **81**, 1009; **82**, 1091; **83**, 854.

Capt. F. A. Hinman, 1884–85. Report, **84**, 1042.

Capt. W. H. Bixby, 1885–92. Reports, **85**, 1060; **86**, 973; **87**, 1013; **88**, 858; **89**, 1048; **90**, 1115; **91**, 1351.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1123; **93**, 1385; **94**, 1022; **95**, 1314.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1103.

Capt. W. E. Craighill, 1897–98. Reports, **97**, 1389; **98**, 1242.

Capt. E. W. Van C. Lucas, 1899–. Reports, **99**, 1492; **1900**, 1801.

ASSISTANTS:

R. Whitford. Reports, **81**, 1010; **88**, 860.

R. Ransom. Reports; **82**, 1092; **83**, 855; **84**, 1042; **85**, 1061; **86**, 975; **87**, 1015 **89**, 1050; **90**, 1117; **91**, 1353.

W. H. Chadbourn, jr. Reports, **96**, 1104; **97**, 1390.

**Operations.**

**1881–82.** Lower 25 miles of river cleared of obstructions; 420 f. of diking built, **82**, 1072; **86**, 976.

**1882–83.** Obstructions cleared to a point 45 miles above the mouth, **83**, 854; **86**, 976.

**1883–84.** 250 stumps removed, **84**, 1042.

**1884–85.** Removal of obstructions continued, **85**, 1060; **86**, 976.

**1885–86.** Removal of obstructions from lower half of river; construction of 400 l. f. of pile dike; repair of old dikes, **86**, 974, 976.

**1886–87.** Removal of obstructions from lower half of river continued; dike and dam construction near the mouth, **87**, 1014, 1015.

**1887–88.** 3,455 logs, snags, and stumps, 2,513 leaning trees, and 740 cords of brush and small snags removed from the channel, **88**, 859.

**1888–89.** 815 logs, stumps, and snags, removed from the channel, and 905 trees removed along shore, **89**, 1049.

**1890–91.** 728 trees, 490 logs, and 245 cords of brush cleared from the banks, and 1,224 snags and logs and 132 c. y. of mud removed from the channel, **91**, 1352.

**1892–93.** 556 large snags, 11 cords small snags, 328 stumps, 401 trees, 304 logs removed from the channel, and 186 stumps, 57 cords small brush, and 861 trees and logs were cut and hauled back on the banks, **93**, 1386.

**1893–94.** 14 snags, 6 stumps, 36 trees, and 11 logs were removed from the channel, and 6 trees were removed on the banks. A plank dike 175 f. long was built at Spring Slough, and was connected through the swamp with the left bank by an earth dike 440 f. long. An old earth dike 370 f. long was repaired by raising it 18 inches and then capping it with logs, **94**, 1023.

**1894–95.** 411 snags, 369 logs, 107 stumps, and 218 trees were removed from the channel, and 263 trees were cut and hauled back on the banks, **95**, 1315.

**1895–96.** 175 trees, 118 logs, 248 snags, 142 stumps, and 2 piles removed from the channel, and 52 logs hauled back, 80 trees cut and hauled back, 2 trees trimmed, and 62 stumps pulled on the banks; 44 cords of brush were placed to repair a break in the bank above Hookerton. A line of levels was run from the third to the thirty-second mile post and gauges established every 3 miles. **96**, 1104.

**1896–97.** 4,051 c. y. dredged, including 76 stumps and 15 logs, snags, and trees; 2 flats, 68 trees, 26 logs, 118 snags, and 98 stumps removed from the channel, and 96 trees cut and hauled back; 6 logs, 33 snags, and 46 stumps hauled back on the banks. **97**, 1390, 1391.

**1897–98.** 162 large snags, 78 logs, 95 stumps, and 48 trees and 29 cords small brush removed from the channel, and 10 stumps hauled back, 16 trees trimmed and 13 cords brush cut on the banks, **98**, 1242.

**1898–99.** 41 snags, 2 stumps, 14 trees removed from channel and 4 trees from the banks, **99**, 1492.

**1899–1900.** 5 logs, 25 snags, 10 stumps, and 69 trees removed from channel and 85 trees from the banks, **1900**, 1801

**Physical characteristics.**

Water-gauge record, 1889, **91**, 1352; for 1892, **93**, 1386. Mean of water-gauge readings, **95**, 1314.

**Projects.**

By Capt. Phillips, 1881, for clearing the creek of obstructions and by dredging and diking so as to secure a depth of 3 f. during nine months of each year, from the mouth to the town of Stantonsburg, a distance of about 70 miles; estimated cost, $40,000, **81**, 1010, 1012. Estimate increased to $78,000, **85**, 1060, 1062; **87**, 1013; **91**, 1351; **92**, 1123.

By Maj. Stanton in 1892–93 for dike at the head of Spring Slough across the main channel to increase the depth in the former, **93**, 1385.

The project of 1881 was amended in 1894 to include maintenance below Snowhill, **96**, 1103.

**Surveys.**

Ordered by act of June 14, 1880, made under the direction of Capt. Phillips, 1880, **81**, 1010.

Survey from Grifton to the mouth of the creek made, 1897–98, by Capt. Craighill, **98**, 1242.

MAPS. **87**, 1014; **90**, 1118; **92**, Atlas, 23.

## CONTINGENCIES. (See *Examinations, etc.*)

## COOPER CREEK, N. J. (See *Woodbury Creek, N. J.*)

**Appropriation.**[a]
1896, $34,500, **96**, 932.

**Commerce.**
Description of, **93**, 1191; **95**, 1104.

**Contracts.**
**1896.** F. C. Somers, repair of dike at mouth of Woodbury Creek at a total cost of $2,500, **97**, 1223. A. M. Clegg, dredging, 13.7 cents per c. y., **97**, 1224. (Proceedings taken to annul contract, **98**, 1100.)

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 129; **95**, 133; **96**, 120; **97**, 152; **98**, 154; **99**, 177; **1900**, 199.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1890–. Reports, **93**, 1189; **95**, 102; **96**, 931; **97**, 1223; (Lt. Col.), **98**, 1100; **99**, 1360; **1900**, 1580.

ASSISTANT. F. Sylvester. Report, **95**, 1104.

**Obstruction.**
List of bridges crossing the stream, **93**, 1190; **95**, 1103.

**Operations.**
**1896–97.** 55 c. y. dredged, **97**, 1224.
**1897–98.** 47,735 c. y. dredged, **98**, 1100.
**1898–99.** 115,640 c. y. dredged, **99**, 1361.

**Physical characteristics.**
Description of, **93**, 1190; **95**, 1103.

**Project.**
By Maj. Raymond, 1895, to dredge a channel 70 f. wide at bottom and 18 f. deep at m. h. w., from mouth of the creek to Brownings Chemical Works; estimated cost, $35,000, **96**, 932.

**Surveys.**
Examination ordered by act of July 13, 1892, made by Maj. Raymond, 1892 (report favorable), **93**, 1190.
Survey ordered by act of Aug. 17, 1894, made under the direction of Maj. Raymond, 1894 (see *Projects*), **95**, 1103.

## COOSA RIVER. (See *Etowah River, Ga.; Transportation Routes to the Seaboard.*)

## COOSA RIVER, ALA. AND GA. (See *Mississippi* and *Tennessee rivers.*)

**Appropriations.**

| | | |
|---|---|---|
| 1876, | $30,000, | **77**, 91 |
| 1878, | 75,000, | **78**, 104,763. |
| 1879, | 45,000, | **79**, 141, 1271. |
| 1880, | 75,000, | **80**, 1690. |
| 1881, | 60,000, | **81**, 1873. |
| 1882, | 83,700, | **82**, 1857. |
| 1884, | 50,000, | **84**, 1656. |
| 1886, | 45,000, | **86**, 1167. |
| 1888, | 60,000, | **88**, 1180. |
| 1890, | 150,000,<br>[b] 150,000, | **90**, 1644. |
| 1892, | 130,000,<br>[b] 100,000, | **92**, 1427, 1430. |
| 1894, | [b] 110,000,<br>[b] 110,000, | **95**, 1674, 1678. |
| 1896, | 50,000,<br>[b] 50,000, | **96**, 1417, 1442. |
| 1899, | 20,000, | **99**, 1687. |
| Total[c] | 1,393,700 | |

**Commerce.**
Important, **71**, 564, 570; **72**, 540; **75**, ii, 663; **79**, 1270.
Commercial necessity for improvement; value of timber lands and coal and iron deposits; natural importance of the work, **88**, 1181; **90**, 1660, 1665, 1673.
Description of, **99**, 1692; **1900**, 2145.

**Contracts.**
**1893.** F. Baldwin, 1891–92, 900 c. y. cut stone; annulled, **93**, 1731. Rodgers, Haller & Farrel, 2 concrete mixers, $750; 1 horizontal engine, $360. T. Carlin's Sons, 1 cement elevator, $153.50; 2 cages for elevator, $105.50; 1 gravity hoisting drum, $205. Ryan-Macdonald Manufacturing Co., 12 dump cars for concrete, $936; 4 dump cars for sand, $252; 4 dump cars for broken stone, $292. **93**, 1733.
**1895.** Sinclair & Babson, 18,000 barrels cement, $2.89 and $2.72 per barrel, **95**, 1679.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **70**, 31, 63; **71**, 64, 69; **72**, 59; **77**, 90; **78**, 104; **79**, 106, 140; **80**, 140, 188; **81**, 189, 255; **82**, 248; **83**, 256; **84**, 256; **85**, 201; **86**, 200; **87**, 168; **88**, 156; **89**, 180, 185; **90**, 162, 167; **91**, 207, 208, 210; **92**, 202; **93**, 224; **94**, 206; **95**, 233; **96**, 205; **97**, 261; **98**, 257; **99**, 300, 301; **1900**, 341, 342.

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[a] $2,500, not included, to be expended in repairing Government reservation dike at mouth of Woodbury Creek, N. J.
[b] Between Wetumpka, Ala., and the East Tennessee, Virginia and Georgia R. R. bridge.
[c] See also Total of allotments for operation of locks.

## COOSA RIVER, ALA. AND GA.—Continued.

BOARDS OF ENGINEERS:

Convened at Nashville, Tenn., Aug. 26, 1896, by S. O. No. 21, Aug. 3, 1895, for consideration of project for construction of Lock No. 4. Report, **96**, 1423. (Maj. F. A. Mahan, Maj. W. L. Marshall, and Capt. John Biddle.)

Convened at Baltimore, Md., Jan. 20, 1897, by S. O. Nos. 42 and 48, H. Q. C. E., Nov. 19, 1896, and Dec. 29, 1896, respectively, to consider and report upon the subject of the improvement of the Coosa River between Wetumpka, Ala., and the East Tennessee, Virginia and Georgia R. R. bridge. Report, **97**, 1650. (Col. P. C. Hains, Maj. R. L. Hoxie, Maj. Wm. T. Rossell, and Lt. W. E. Craighill.)

ENGINEERS IN CHARGE:

Maj. C. B. Reese, 1870. **70**, 63.

Capt. A. N. Damrell, 1870. **70**, 63.

Col. J. H. Simpson, 1870. Report, **71**, 562.

Maj. W. McFarland, 1871–75. Reports, **71**, 561; **72**, 502, 516; **75**, ii, 661.

Capt. W. R. King, 1877–85. Reports, **77**, 579; **78**, 762; **79**, 1269; (Maj.), **80**, 1689; **81**, 1870; **82**, 1855; **83**, 1501; **84**, 1654.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1301; **86**, 1165; **87**, 1281; **88**, 1178.

Capt. P. M. Price, 1889-93. Reports, **89**, 1389, 2797; **90**, 1640, 1658; **91**, 1743, 1753; **92**, 1424; **93**, 1724.

Maj. F. A. Mahan, 1893–98. Reports, **94**, 1285, 1286, 1291; **95**, 1670, 1671, 1674; **96**, 1407, 1418; **97**, 1642, 1647; **98**, 1413, 1418.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1682, 1689; **1900**, 2137, 2143.

ASSISTANTS:

H. C. Fillebrown. Report, **71**, 564.

J. C. Long. Report, **72**, 536.

B. W. Frobel. Report, **75**, ii, 562.

R. C. McCalla. Report, **78**, 763.

Lt. W. L. Marshall. Reports, **77**, 597; **78**, 763; **79**, 1269; **80**, 1690.

D. M. Andrews. Reports, **89**, 1391; **90**, 1643.

C. Firth. Reports, **90**, 1674; **91**, 1748; **92**, 1428.

Lt. W. E. Craighill. Report, **93**, 1726.

**Estimates.** (See *Plans* and *Projects.*)

By Col. Simpson, 1871, completion of survey, $6,000, **71**, 563.

By H. C. Fillebrown, 1871, removing obstructions from river, 77 miles, Greensport to Selma, Rome and Dalton R. R. crossing, $278,484.50, **71**, 570–572.

By Maj. McFarland, 1872, channel for vessels drawing 3 f. of water, from Greensport to Wetumpka, 134 miles, $2,340,746.75, **72**, 505; from Wetumpka to Selma, Rome and Dalton R. R. crossing, $1,923,020, **72**, 507.

By Maj. McFarland, 1874, 4-f. channel Rome to Mills Creek, $180,000, **75**, ii, 662.

By B. W. Frobel, 1875, channel 80 f. by 4 f., Rome, Ga., to mouth of Great Mills Creek, 120 miles, $81,679, **75**, ii, 664–668.

By J. C. Long, 1872, channel from near Wilsonville to Greensport, 94 miles, $470,668, **72**, 543.

By Lt. Marshall, 1877, 3-f. channel Selma, Rome and Dalton R. R. bridge to Greensport, $313,000, **77**, 598.

By Lt. Marshall, 1878, dams, locks, and riprapping at Whistenant's and Ten Island Shoals, $155,616.23, **78**, 766.

By Capt. King, 1879, completion of existing project, $402,347, **79**, 1271.

**Legal proceedings.**

Title to land at Lock No. 31 obtained by condemnation proceedings in 1893, **93**, 1730.

**Obstructions.**

Bridges obstructing navigation, **89**, 2797.

**Operations.**

**1876–77.** Begun at Horseleg Shoals, near Rome, **77**, 597.

**1877–78.** At various shoals between Rome and Greensport, **79**, 140, 1269.

**1879–80.** 1,039 c. y. rock excavated from channel; 6,124 c. y. rock quarried; 3,714 c. y. rock placed in dams; 3,350 c. y. gravel, etc., excavated; 12,756 c. y. earth embankment raised, **80**, 1689.

**1880–81.** 4,219 c. y. masonry laid; 1,362 c. y. stone quarried; 1,945 c. y. solid and 12,645 c. y. loose rock excavated; 7,040 c. y. earth embankment raised, **81**, 1872.

**1881–82.** 3,154 c. y. masonry laid; 610 c. y. dimension stone cut; 9,191 c. y. stone quarried, and 14,312 c. y. stone placed in dams and locks; 10,898 c. y. earth and gravel placed in dams and embankments; 740 f. cribbing built, **82**, 1856.

**1882–83.** 7,686 c. y. stone cut and quarried; 18,597 c. y. stone and gravel placed in riprap dams; 359 c. y. solid rock excavated; 1,140 c. y. loose rock and gravel excavated; 2,016 c. y. earth excavated, **83**, 1502.

**1883–84.** 634 c. y. stone and gravel placed in riprap dams; 1,169 c. y. solid rock excavated; 474 c. y. gravel, etc., excavated; lock gates for lock No. 1 completed, **84**, 1655.

**1884–85.** 6,363 c. y. stone cut; 4,406 c. y. stone built into locks; 1,922 c. y. stone built into rubble dams; 3,093 c. y. solid rock excavated; 9,846 c. y. earth excavated, **85**, 1302.

**1885–86.** 1,055 c. y. stone quarried and dressed; 143 c. y. solid rock excavated from channel, **86**, 1166.

## COOSA RIVER, ALA. AND GA.—Continued.

**1886–87.** Progress on lock and dam construction at Ten Island Shoals, and at lock and dam No. 4, **87**, 1282.

**1887–88.** Construction of lock and dam No. 4 continued, **88**, 1180.

**1888–89.** 8,583 c. y. dredged; 306 c. y. loose rock and 90 c. y. solid rock removed; 1,828 c. y. masonry and concrete laid; 3,305 c. y. stone quarried, and 258 logs and snags removed, **89**, 1392.

**1889–90.** Lock No. 1 completed and opened to navigation; operations continued upon locks Nos. 2 and 3; obstructions removed from the river between locks 1 and 2, **90**, 1643, 1644.

**1890–91.** Lock No. 2 completed; operations continued upon lock No. 3; work begun upon lock No. 4; excavation of channel through Lonnergan Reef in progress, **91**, 1746.

**1891–92.** Upper section, between Rome and the East Tennessee, Virginia and Georgia R. R. Bridge: Repairs to dam at lock No. 3, and guide crib above the lock filled with stone; 222 l. f. stone dam built at foot of Wood Island; 1,096 c. y. rock removed from the channel at Lonnergan Reef, and timber guide cribs built; dam abutment, cofferdam, and lock house completed at lock No. 4, **92**, 1425, 1426. Lower section, between Wetumpka, Ala., and the East Tennessee, Virginia and Georgia R. R. Bridge: Erection and preparation of plant and commencement of rock excavation in construction of lock at Wetumpka, **92**, 1428.

**1892–93.** Construction of lock No. 4 in progress; 3,208 c. y. rock excavated at Box Shoals; repair and construction of lock No. 31 in progress, and 6,266 c. y. rock excavated at the head of the lock, **93**, 1730, 1732.

**1893–94.** Construction of lock No. 4 in progress and channel at Box Shoals deepened, **94**, 1287, 1288; construction of lock No. 31 continued, and 14,505 c. y. excavated in the vicinity of the lock. A railroad was also built to connect the site of the lock with the head of the rapids. **94**, 1294.

**1894–95.** Work continued on lock No. 4, **95**, 1672; repairs made to wing and training dams at Horseleg Shoals, and obstructions removed; blasting and dredging done between locks Nos. 3 and 4, **95**, 1673; work on lock No. 31 continued, and 8,199 c. y. rock excavated above the lock, **95**, 1675, 1676.

**1895–96.** Work at lock No. 31 continued, and 11,131 c. y. rock excavated from channel above, **96**, 1420, 1422.

**1896–97.** Repairs made to dam No. 4, and preparations for work at lock No. 4 made; 6,542 c. y. dredged from the channel, and some blasting done at Box Shoals, **97**, 1645; works of construction removed from lock No. 31, **97**, 1648.

**1897–98.** Dam construction in progress at Horseleg Shoals; dredging was done at and obstructions removed from the channel at Shorters Island and Mays Bar; sand and gravel for concrete were dredged, and the channel at the head of Box Shoals dredged; the construction of lock No. 31 was continued, **98**, 1415, 1416.

**1898–99.** 1,040 l. f. dam built at Horseleg Shoals; blasting, dredging, and building dams between locks Nos. 3 and 4, **99**, 1685.

**1899–1900.** 1,305 l. f. dam built at Lonnergan Reef; 640 l. f. built at Whiteside Bar, and blasting, dredging, and building dams between locks Nos. 3 and 4, **1900**, 2140, 2141.

**Physical characteristics.**

Description of, **71**, 563, 570; **72**, 502, 536, 540; **77**, 598; **78**, 763; **90**, 1659–1666, 1669; **91**, 1744; **98**, 1413, 1418; **99**, 1688.

Character of banks and slope of river bed, **89**, 1390.

Description of the locality surveyed for locks Nos. 9 and 10 in 1898–1899, **98**, 1420.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Damrell, 1880, Selma, Rome and Dalton R. R. Bridge to city of Wetumpka, Ala., system of locks and dams, short stretches of canal, and removal of rocks from channel at various points; estimate, $2,649,949, **81**, 1222.

**Projects.** (See *Estimates* and *Plans.*)

By Capt. King, 1877, improvement Greensport to Selma, Rome and Dalton R. R. Bridge by excavation of a channel 80 f. wide and 4 f. deep at extreme low water, and by a system of locks and dams around Ten Island Shoals; estimate, $560,663, **77**, 598; **81**, 1871; **87**, 1281.

By Capt. King and Lt. Marshall, 1878, dams and locks at Whistenant's Mill and Ten Island Shoals; estimate, $155,616.23, **78**, 766.

The estimates of the cost of this work have been increased from time to time on account of inadequate appropriations and modifications of the original project, consisting mainly of the adoption of a better quality of work for the locks, cut-stone masonry being substituted for wooden cribs. In 1889 the estimate for completion was $225,000, making a total estimate of $748,700. **89**, 1390, 1391.

By Capt. Price, 1889, improvement, rapids at Wetumpka to improvements already completed above the Ten Islands, giving a complete system of slack-water

## COOSA RIVER, ALA. AND GA.—Continued.

navigation with a minimum channel depth of 6 f.; by removal of rock and the construction of 27 locks and dams, the locks to be 52 f. wide and 320 f. between miter sills; estimated, $6,074,913, **90**, 1670, 1672, 1677, 1686.

In 1890 the estimate for completion of the improvement between Rome and the East Tennessee, Virginia and Georgia R. R. bridge, exclusive of the appropriation of 1890, was $971,840, **90**, 1641, 1642, 1644.

For prior projects see **90**, 1667, 1668.

The act of September 19, 1890, making an aggregate appropriation of $300,000 for the improvement of the Coosa River, fixed the dimensions of the locks at 40 f. width, with 210 f. between miter sills; estimated for completion of 31 locks and dams, $6,033,207, **91**, 1744, 1747, 1752.

Congress removed restrictions as to sizes of locks imposed by act of September 19, 1890, **97**, 1644.

By Capt. Price, 1893, for the abandonment of cut stone in lock walls of lock No. 31, except for quoins, and for adoption instead of a facing of concrete, **93**, 1731.

By Board of Engineers, 1896, for modification of construction of concrete floor of lock No. 4, **96**, 1423.

**Surveys.**

By H. C. Fillebrown, 1870–71, under direction of Maj. Reese, Capt. Damrell, Col. Simpson, and Maj. McFarland. Reports, **71**, 561, 562, 564; **72**, 502.

By J. C. Long, under direction of Maj. McFarland. Reports, **72**, 516, 536.

By B. W. Frobel, 1874, under direction of Maj. McFarland. Reports, **75**, ii, 661, 662.

By R. C. McCalla, under direction of Capt. King, and Lt. Marshall. Reports, **78**, 762, 763.

Under direction of Capt. Damrell, **79**, 106.

Detailed survey of 24 miles of river below lock No. 3, **82**, 1856.

Ordered by act of March 3, 1879, made under direction of Capt. Damrell, 1880, Selma, Rome and Dalton Railroad bridge to Wetumpka, Ala., **81**, 1221.

Of Coosa River from rapids at Wetumpka to Ten Islands ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Price, **90**, 1658, 1665.

Survey of the proposed sites for locks Nos. 9 and 10 was commenced in 1898, **98**, 1419.

MAPS.

Of Ten Island shoals, **78**, 764.

**90**, 1644; **91**, 1752; **92**, Atlas, 68, 69; **94**, 1288.

Box shoals, **93**, 1726.

Stone crushing plant at lock No. 4, **95**, 1678.

## COOSA RIVER, ALA. AND GA. (Operation and care of canals.)

**Appropriations.**[a]

| | |
|---|---|
| 1890, | $326.42. |
| 1891, | 2,530.67. |
| 1892, | 6,137.49. |
| 1893, | 9,366.56. |
| 1894, | 3,418.16. |
| 1895, | 3,982.66. |
| 1896, | 8,797.12. |
| 1897, | 6,137.92. |
| 1898, | 2,281.98. |
| 1899, | 7,141.60. |
| 1900, | 5,907.16. |
| Total, | 56,027.74. |

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 226; **94**, 208; **95**, 235; **96**, 207; **97**, 262; **98**, 259; **99**, 302; **1900**, 343.

ENGINEERS IN CHARGE:

Capt. P. M. Price, 1893. Report, **93**, 1734.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1297; **95**, 1679; **96**, 1423; **97**, 1654; **98**, 1422.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1692; **1900**, 2145.

**Operations.**

**1893–1900**. Repairs and improvements made to locks and dams in operation, **93**, 1734; **94**, 1297; **95**, 1679; **98**, 1422.

Repairs made to dam No. 4, and lock No. 2, **1900**, 2145.

**Surveys.**

MAPS. Safety latch for valve levers, **93**, 1734.

## COOSA RIVER TO TENNESSEE RIVER. (See *Tennessee* and *Coosa rivers, etc.*)

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[a] Expenditures under permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## COOSAWATTEE AND OOSTENAULA RIVERS, GA. (See *Oostenaula* and *Coosawattee rivers, Ga.*)

## COOS BAY AND HARBOR, OREG. (See *Coquille River.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1879, | $40,000, | **79**, | 182. |
| 1881, | 30,000, | **81**, | 2585. |
| 1882, | 30,000, | **83**, | 2677. |
| 1884, | 30,000, | **84**, | 2261. |
| 1886, | 33,750, | **86**, | 1992. |
| 1888, | 50,000, | **88**, | 2143. |
| 1890, | 125,000, | **90**, | 2933. |
| 1892, | 210,000, | **92**, | 2674. |
| 1894, | 95,000, | **95**, | 3361. |
| 1896, | 95,000, | **96**, | 3234. |
| 1899, | 150,000, | **99**, | 3204. |

Total, $888,750

**Commerce.**

Benefit of improvement to commerce, **79**, 1854.

Lumber and coal interests, **90**, 2931, 2932.

Tabular record of exports from Coos Bay from 1879 to 1891, **91**, 3167.

Important and increasing, **93**, 3337; **94**, 2565; **95**, 3361.

**Contracts.**

**1889.** P. O'Neil, stone, $1.39 per c. y., **89**, 2508.

**1892.** P. O'Neil, brush fascines, $2 per cord, **92**, 2670.

**1892–93.** D. Kern, supplying stone from Government quarry, 53½ cents per ton ($53,500), **93**, 3334.

**1894.** D. Kern, furnishing stone, 63 cents per ton ($18,900), **95**, 3359.

**1896.** Wakefield & Jacobsen, furnishing and placing rock, 52½ cents per ton ($42,000), **97**, 3386.

**1899.** Wakefield & Jacobsen, repair of wharf and north jetty tramway, and completion of north jetty (piles, lumber, rails, and other ironwork, stone), $123,710, **1900**, 4279.

**Engineers.**

Chief of Engineers. Reports, **78**, 139; **79**, 182, 183; **80**, 940; **81**, 328; **82**, 321; **83**, 334; **84**, 338; **85**, 365; **86**, 361; **87**, 325; **88**, 297; **89**, 354; **90**, 318; **91**, 401, 410; **92**, 376; **93**, 434; **94**, 403; **95**, 443; **96**, 395; **97**, 496; **98**, 483; **99**, 567; **1900**, 640.

Board of Engineers. Convened at Portland, Oreg., Nov. 18, 1888, by S. O. No. 58, to examine and report upon project for improvement of Coos Bay. Reports, **89**, 2510; **90**, 2936. (Col. Mendell and Majs. Jones and Handbury.)

Engineers in Charge:

Maj. J. M. Wilson. Report, **79**, 1791.

Maj. G. L. Gillespie, 1879–82, **79**, 180, 183. Reports, **79**, 1854; **80**, 2323; **81**, 2583.

Lt. Col. C. Seaforth, 1882–83. Report, **82**, 2674.

Capt. C. E. Powell, 1883–87. Reports, **83**, 2055; **84**, 2260; **85**, 2388; **86**, 1989; **87**, 2460.

Capt. W. Young, 1888–90. Reports, **88**, 2141; **89**, 2507.

Capt. T. W. Symons, 1890–95. Reports, **90**, 2929; **91**, 3154, 3283; **92**, 2669; **93**, 3332; **94**, 2561; **95**, 3357.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3233; **97**, 3384; (Maj.), **98**, 2963.

Capt. W. W. Harts, 1899–. Reports, 3203; **1900**, 4274.

Assistants:

C. M. Bolton, **79**, 1791, 1794. Report, **79**, 1795.

Lt. A. H. Payson. Report, **80**, 2326.

R. S. Littlefield. Reports, **81**, 2585; **83**, 2058; **84**, 2262; **85**, 2390; **90**, 2933.

J. S. Polhemus. Reports, **91**, 3163; **92**, 2674; **93**, 3338; **94**, 2565; **95**, 3361.

J. R. Savage. Report, **92**, 2672.

**Operations.**

**1879–80.** 450 l. f. of crib work sunk, **80**, 2325.

**1880–81.** 250 l. f. crib work sunk, **81**, 2583.

**1881–82.** Shore interval closed by addition of 210 l. f. crib work; 7,236 c. y. stone placed for jetty extension; 6 dump cars and 1 derrick car constructed, **82**, 2675, 2676.

**1882–83.** Jetty track repaired and extended; 14,063 c. y. stone placed in jetty, making a total length of work of 1,645 l. f., **83**, 2056, 2057.

**1883–84.** 6,856 c. y. rock placed, extending jetty 42 f.; 433 c. y. rock placed in inside part of jetty, **84**, 2260.

**1884–85.** Enrockment advanced 72 f.; quarrying and sluicing operations carried on, **85**, 2389.

**1886–87.** Clearing quarry for use, **87**, 2460.

**1887–88.** 7,000 c. y. of earth removed in quarry sluicing, **88**, 2142.

**1888–89.** 3,314 c. y. stone placed in foundation of jetty extension, **89**, 2508.

**1889–90.** 38,845 c. y. stone placed in extension of the jetty, **90**, 2930–2933.

**1890–91.** 1,841 c. y. rock deposited in the jetty; 1,600 l. f. of stone trestle built, and plant constructed for commencement of north jetty work, **91**, 3164.

**1891–92.** 3,200 l. f. of jetty tramway built; 23,923 tons rock placed in the jetty; 4,336 l. f. of mattress work placed, **92**, 2671.

**1892–93.** 41,000 tons of stone placed in north jetty, **93**, 3335. Reclamation of sand dunes in progress, **93**, 3336.

## COOS BAY AND HARBOR, OREG.—Continued.

**1893-94.** 117,340 tons of stone placed in north jetty and some repairs made, **94,** 2563, 2564.

**1894-95.** About 98,000 tons of stone placed in north jetty and some repairs made, **95,** 3359, 3360.

**1895-96.** Maintenance of work already done, **96,** 3234.

**1896-97.** About 80,000 tons of stone placed in north jetty, **97,** 3385.

**1897-98.** 67,728 tons of stone placed in north jetty, **98,** 2964.

**1899-1900.** Wharf and north jetty tramway repaired; 105,500 tons stone placed in north jetty (photographs); grass planted in an apparently successful effort to check sand movement at entrance of bay, **1900,** 4276, 4278.

**Physical characteristics.**

Description of, **79,** 1792, 1793, 1795; **94,** 2563; **95,** 3359.

Tides and currents, **79,** 1793.

Description of obstructions in Coos Bay, **80,** 2324.

Influence exerted by jetties, **81,** 2583.

Benefit conferred by improvement, **86,** 1995, 1996, 1997.

Description of the locality, **90,** 2930, 2938, 2944.

Tidal capacity of Coos Bay, **90,** 2940.

Movement of sand, **90,** 2941; **91,** 3158.

Unusually heavy storms during winter of 1899–1900 caused temporary shoaling, **1900,** 4277.

**Plans.**

By Maj. Wilson, 1879, for improving entrance with two stone training walls to obtain a channel 22 f. at l. w.; estimate, $972,000, **79,** 182, 1796. Referred to Board of Engineers, **79,** 1793, 1794, 1795, 1796, 1854.

By Capt. Symons, 1891, for improvement of the upper harbor at Coos Bay by dredging a channel through the shoal at the lower end of Marshfield and one above the coal bunkers in Isthmus Slough to a depth of 10 f. at l. w. and a bottom width of 100 f.; estimate, including the construction of dredge and equipment, $27,390, **91,** 3285.

**Private work.**

Continuation of operations during season of 1881–82 after funds had been exhausted through materials and labor furnished by citizens, **82,** 2676.

**Projects.**

By Maj. Gillespie, 1879, for half-tide jetty, from near Fossil Point, in a curved line toward Coos Head, to open and maintain a deeper and more direct channel across the outer bar; estimate, $600,000, **80,** 2323; **83,** 2055; **87,** 2460; **88,** 2142.

By Board of Engineers, 1889, improvement of the bay, securing a low-water depth of 20 f. through the bar at its entrance with two parallel jetties of riprap stone upon mattress foundation, crossing the bar at a distance apart of 1,500 f.; the north jetty to be 9,600 f. in length; the south jetty to be 4,200 f. in length; both jetties to be brought to high-water level, and to have a top width of 10 f.; estimate, $2,466,412, **90,** 2941, 2942.

Projected low-tide depth of 20 f. on the bar at the entrance probably not to be obtained through the agency of the north jetty alone, **99,** 3203.

Certain tracts of land reserved for the use of the improvement of the bay and harbor restored to the public domain, **1900,** 4278.

**Surveys.**

Ordered and in progress, **78,** 139.

Of entrance completed by C. M. Bolton, **79,** 183, 1791, 1795.

Examination into condition of jetty, channel, and sand spits, **85,** 2389.

Survey of entrance and outer harbor, 1886, **86,** 1989.

Surveys of Lower Coos Bay made, 1889, under direction of Capt. Young, **90,** 2948.

Survey of Coos Bay for improvement of the upper harbor made, 1891, under direction of Capt. Symons, **91,** 3284.

Surveys of the bar channel were made by Capt. Symons in 1894, **94,** 2563; in 1895, **95,** 3359.

Survey of the entrance made, 1899, by Capt. Harts (maps), **1900,** 4277.

MAPS. **82,** 2676; **83,** 2060; **84,** 2264; **85,** 2390; **86,** 1989; **91,** 3163; **93,** 3336; **94,** 2568; **95,** 3366; **1900,** 4278.

PHOTOGRAPHS. **1900,** 4278.

## COOS BAY, OREG.

**Appropriations.**

1894, $13,000, **95,** 3369.
1896, 14,390, **96,** 3235.

Total, 27,390

**Commerce.**

In the two years preceding 1900 the commerce averaged about 125,000 tons per annum, **1900,** 644.

**Contracts.**

**1899.** W. N. Concanon, dredging, 19⅞ cents per c. y., p. m., **99,** 3207; ($20,-828.60), **1900,** 4281.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95,** 444; **96,** 396; **97,** 497, **98,** 484; **99,** 568; **1900,** 642.

## COOS BAY, OREG.—Continued.

ENGINEERS IN CHARGE:

Capt. T. W. Symons, 1890–95. Report, **95**, 3367.

Capt. H. Taylor, 1896–98. Reports, **96**, 3235; **97**, 3387; **98**, 2966.

Capt. W. W. Harts, 1899–. Reports, **99**, 3205; **1900**, 4280.

**Obstructions.**

Raft cradle, owned by unknown persons, a hindrance to free navigation, removed, 1900, **1900**, 4282.

**Operations.**

**1898–99.** 75,770 c. y. dredged (maps), **99**, 3206.

**1899–1900.** 30,000 c. y. dredged; raft cradle removed; small dike built, **1900**, 4280–4282.

**Physical characteristics.**

Description of. In the upper part of Coos Bay and its tributary sloughs in 1895 there were a number of shoals which interfered with navigation, the principal of which was situated just below the town of Marshfield, situated at the upper end of the bay, **95**, 3367.

**Projects.**

By Capt. Symons, in 1891, for building a dredge to dredge a channel 10 f. deep through two shoals in the harbor; estimate, $27,390, **95**, 3367.

Existing project amended by Congress, 1899, so as to dispense with the necessity of purchasing dredging boat and scows, that dredging might be done by contract or otherwise, **99**, 3205.

By Capt. Harts, 1899, dredging a 13-f. channel, 150 f. wide, through three shoals near Marshfield, and a 13-f. channel, 100 f. wide, through a fourth shoal in the same locality, **99**, 3205.

By Capt. Harts, 1899, dike across the channel south of an island in the harbor; estimate, $500, **1900**, 4282.

**Surveys.**

Minor survey, **99**, 3205.

MAPS. **99**, 3206.

## COOS RIVER, OREG.

**Appropriations.**

1896, $5,000, **96**, 3236.
1899, 3,000, **99**, 3205.

Total, 8,000

**Commerce.**

Increasing at 1900; over 70,000 tons annually, **1900**, 645.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 445; **95**, 459; **96**, 396; **97**, 498; **98**, 485; **99**, 570; **1900**, 644.

ENGINEERS IN CHARGE:

Capt. T. W. Symons, 1893–95. Reports, **93**, 3437; **95**, 3502.

Capt. W. L. Fisk, 1896. Reports, **96**, 3236; **97**, 3388; (Maj.), **98**, 2966.

Capt. W. W. Hart, 1899–. Reports, **99**, 3208; **1900**, 4283.

ASSISTANT. J. S. Polhemus. Reports, **93**, 3439; **95**, 3503.

**Operations.**

**1896–97.** A limited amount of snagging done and a small training dike constructed, **97**, 3388.

**1897–98.** 1,050 tons of rock used in the construction of a dike 400 f. long and about 1,600 snags and other like obstructions removed; 862 bowlders removed. Project completed, **98**, 2966.

**1898–99.** Nearly 1,000 snags, etc., removed, **99**, 3208.

**1899–1900.** About 1,000 snags, etc., removed. Project completed. Snag scow strengthened and fitted with a dredging bucket, **1900**, 4284.

**Physical characteristics.**

Description of, **93**, 3438; **95**, 3502.

The river is the chief tributary of Coos Bay, being about 6 miles long, then separating into two forks, up which the tide ranges for about 8 miles from the junction. The valley along the streams in a good state of cultivation, **93**, 3438.

**Projects.**

In 1895 Capt. Symons estimated it would cost $5,000 to improve the river, **95**, 3502; by removal of snags and other like obstructions, cutting through bars where necessary to secure a channel 50 f. wide, from the mouth of the river to the head of navigation in the north and south forks, including 5½ miles of the main river and about 8½ miles of each fork. The project adopted, **96**, 3236.

By Capt. Fisk, 1898, channel 50 f. wide, free of bowlders and obstructing snags from the river mouth in Coos Bay to the head of tide, on the south and north forks; estimate, $3,000, **99**, 2966; **1900**, 3208.

In 1900 Capt. Harts estimated it would cost $1,500 every two years for maintenance, **1900**, 4284.

**Surveys.**

Examination of the navigable tidewater channels of the river with a view to the removal of snags and other obstructions ordered by act of July 13, 1892, made in the same year under the direction of Capt. Symons (report favorable), **93**, 3437.

Survey ordered by act of Aug. 17, 1894, made in 1895 under the direction of Capt. Symons (see *Projects*), **95**, 3502.

## COPPER HARBOR, MICH.

**Commerce.**

Description of. No local commerce (see *Physical characteristics*), **1900**, 3638.

**Engineers.**

Chief of Engineers. Report, **1900**, 522.

Engineer in Charge. Maj. C. B. Sears, 1899–1900. Reports, **1900**, 3636, 3641.

Assistant. M. W. Lewis. Report, **1900**, 3639.

**Physical characteristics.**

Description of. A snug land-locked harbor, 3 miles long and of 1,700 f. average width, situated at the most northerly point of the Great Keweenaw peninsula. About 70 per cent of the total tonnage passing through the "Soo" Canal passes within a few miles, **1900**, 3637.

**Projects.**

Maj. Sears, 1899, estimated it would cost $2,000 to remove a small shoal, **1900**, 3637.

**Surveys.**

Examination and survey for 18-f. depth (already existing), ordered by act of Mar. 3, 1899, made under direction of Maj. Sears, 1899 (report favorable; see *Projects*), **1900**, 3636.

## COQUILLE RIVER. (See *Coos Bay, Harbor and River, Oreg.*)

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $10,000, | **80**, 241. |
| 1882, | 10,000, | **82**, 2683. |
| 1884, | 10,000, | **84**, 2271. |
| 1886, | 20,000, | **86**, 2004. |
| 1888, | 25,000, | **88**, 2140. |
| 1890, | 30,000, | **90**, 2927. |
| 1892, | 25,000, | **92**, 2665. |
| 1894, | 20,000, | **95**, 3344. |
| 1896, | 20,000, | **96**, 3229. |
| 1899, | 40,000, | **99**, 3201. |
| Total, | 210,000 | |

**Commerce.**

Methods of transportation, **74**, ii, 366; **79**, 1807, 1809.

Description of, **79**, 1808; **85**, 2401.

Increasing at 1900, **1900**, 638.

**Contracts.**

**1891.** W. R. Pauter, piles, 5 cents per l. f. E. Fahy, lease of quarry, $100 per annum. Capt. Parker, furnishing scows and steamboat, and towing rock from the quarry to the wharf, $1 per c. y. **91**, 3147.

**1895.** Nickum & Jacobsen, jetty construction; piles, 8 cents per l. f.; lumber, $9.50 per 1,000 f.; ironwork, 3 and 4½ cents per lb.; brush mattresses, 35 cents per c. y.; stone, 58 cents per ton; **95**, 3345.

**1896.** D. Kern, jetty construction; piles, 8½ cents per l. f; lumber, $9 per 1,000 f.; ironwork, 3, 4, and 5 cents per lb.; mattresses, 35 cents per c. y.; stone, 63 cents per ton; **97**, 3382.

**1899.** J. Kiernan, jetty construction and tramway repair, (piles, lumber, ironwork, mattresses, stone), $33,568, **1900**, 4270.

**Engineers.**

Chief of Engineers. Reports, **73**, 108; **74**, 118; **78**, 139; **79**, 183; **80**, 241; **81**, 330; **82**, 322; **83**, 336; **84**, 339; **85**, 366; **86**, 362; **87**, 325, 330; **88**, 296; **89**, 353; **90**, 317; **91**, 399; **92**, 375; **93**, 432, **94**, 402; **95**, 441; **96**, 394; **97**, 495; **98**, 480; **99**, 563; **1900**, 636.

Engineers in Charge:

Maj. H. M. Robert, 1873; **73**, 108. Report, **74**, ii, 364.

Maj. N. Michler, 1874; **74**, 117. Report, **74**, ii, 364.

Maj. J. M. Wilson, 1878–79; **78**, 137; **79**, 183. Report, **79**, 1806.

Maj. G. L. Gillespie, 1880–82. Report, **81**, 2596.

Capt. C. F. Powell, 1882–87. Reports, **82**, 2682; **83**, 2068; **84**, 2270; **85**, 2398; **86**, 2003; **87**, 2458, 2498.

Capt. W. Young, 1888–90. Reports, **88**, 2137; **89**, 2503.

Capt. T. W. Symons, 1890–95. Reports, **90**, 2924; **91**, 3146; **92**, 2662; **93**, 3324; **94**, 2553; **95**, 3344.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3228; **97**, 3380; (Maj.) **98**, 2958.

Capt. Harts, 1899–. Reports, **99**, 3200; **1900**, 4266.

Assistants:

C. M. Bolton, **79**, 1806. Report, **79**, 1809.

R. S. Littlefield. Reports, **81**, 2598; **83**, 2070; **85**, 2400; **92**, 2667; **93**, 3326; **94**, 2556; **95**, 3346.

J. S. Polhemus. Report, **96**, 3230.

**Estimates.**

By Maj. Michler, canal from Low's place to Coos Bay, $349,592, **74**, ii, 368.

By Maj. Wilson, dams and training walls at mouth, $164,200, **79**, 1808, 1810.

**Operations.**

**1880–81.** 50 l. f. of riprap jetty, with central core of timber boxes constructed, **81**, 2597.

**1881–82.** Addition of 100 l. f. to jetty and temporary elevation to high-water line by addition of plank parapet; cribs riprapped, **82**, 2682, 2683.

**1882–83.** Jetty extended by 360 l. f. piling and 58 l. f. riprap, **83**, 2069.

## COQUILLE RIVER.—Continued.

**1884–85.** 422 l. f. close piling driven; 860 c. y. stone ballast quarried and placed in jetty, **85**, 2399.

**1886–87.** Extension of pile jetty to a length of 1,626 f., **87**, 2458.

**1887–88.** Jetty extended 300 l. f. by 14,235 l. f. of piling and 3.384 c. y. of stone, **88**, 2138.

**1888–89.** 4,000 c. y. stone quarried and placed in jetty, and 1,944 f. of tramway built, **89**, 2504,

**1889–90.** Rock removed and snagging, **90**, 2925.

**1890–91.** 327 snags and 69 scow loads of drift cleared from the river; plant prepared for extension of north jetty, **91**, 3147.

**1891–92.** 1,500 c. y. stone placed in the jetty; erection of buildings and construction of plant, **92**, 2663.

**1892–93.** North and south jetties strengthened and repaired, **93**, 3325.

**1893–94.** South jetty strengthened and north jetty repaired, **94**, 2555.

**1894–95.** Preparations made for commencement of jetty construction, **95**, 3346.

**1895–96.** South jetty strengthened and extended 224 f., **96**, 3229.

**1896–97.** Extension of south jetty in progress, **97**, 3381.

**1897–98.** In connection with previous year, the south jetty was extended 270 f. (total length of jetty, 2,387 f.), **98**, 2959.

**1899–1900.** South jetty tramway repaired and extended. 19,739 short tons stone placed in jetty. Unsuccessful attempt made to remove large rock. **1900**, 4267–4269.

**Physical characteristics.**

Description of, **74**, ii, 365, 366, 367; **79**, 1806, 1807, 1809.

Fertility of valley tributary to river, **74**, ii, 365; **79**, 1807, 1809.

High-water marks, **74**, ii, 367; **79**, 1807.

Effect of incomplete jetties, **99**, 3200.

Unusually heavy storms, 1899–1900, **1900**, 4268.

The least low-tide depth in the channel, survey of 1899, was 6 f., **1900**, 4289.

**Plans.** (See *Projects.*)

By Maj. Michler, 1874, canal from Low's place, on Coquille River, to Coos Bay, 27,180 f. by 30 f. by 4 f. deep at low-water mark; estimate $349,592, **74**, ii, 367, 368.

By Maj. Wilson, 1878, to improve the mouth of river by continuing work on dams and training-walls commenced by private parties, the object of the work being to produce scouring effect on the inlet; estimate $164,200, **79**, 1808, 1810.

By Capt. Powell, 1887, snagging, Coquille City to Myrtle Point· cost, $5.000, **87**, 2499.

**Private work.**

Private parties began a dam 600 f. below mouth, with training-walls to produce scouring; work suspended, **79**, 1808, 1809.

Elevation of jetty by private work, **83**, 2068.

**Projects.** (See *Plans.*)

By Maj. Wilson, 1878, improvement of the bar at the mouth to give a channel 10 f. deep at m. l. w., with training-walls; estimate $164,200, **79**, 1808, 1810; **81**, 2599.

In 1891 Capt. Symons estimated the cost of completing the project at $130,000, including the extension of the south jetty 700 f., and the completion of the north jetty to an equal length, making the total revised cost of the project $228,000, **91**, 3148.

In 1892 Capt. Symons estimated the cost of completing the project at $180,718, **92**, 2665.

By Capt. Symons, 1894–95, to abandon the old system of single-track and close-pile tramway, replacing it with the regular open-work pile-bent, double-track tramway, and for building the enrockment on a brush mattress, **95**, 3345.

Capt. Harts estimated, 1899, it would cost $75,000, if appropriated at one time, to complete the north jetty, **1900**, 4269.

**Surveys.**

Examination of navigable outlet ordered, **73**, 108; **74**, 118; made by Maj. Michler, **74**, ii, 364.

Survey ordered; completed by C. M. Bolton, **78**, 139; **79**, 183, 1809.

Made, 1880, under direction of Maj. Gillespie, **81**, 2596.

Examination into condition of channel and jetty, **84**, 2270.

Examination ordered between Coquille and Myrtle Point by act of Aug. 5, 1886; made, 1887, under direction of Capt. Powell, **87**, 2499.

Survey of the mouth to ascertain the effect of incomplete jetties made, 1899, by Capt. Harts, **1900**, 4269.

MAPS. **82**, 2682: **83**, 2072; **84**, 2270; **85**, 2400. Mouth, **86**, 2003; **91**, 3151; **93**, 3324; **1900**, 4270.

PHOTOGRAPHS. Jetties, **99**, 3200.

## COQUILLE RIVER, OREG. (Coquille City to Myrtle Point).

(See *Coquille River.*)

**Appropriations.**

| | | |
|---|---|---|
| 1892, | $5,000, | **93**, 3329. |
| 1894, | 5,000, | **95**, 3349. |
| 1896, | 12,000, | **96**, 3232. |
| 1899, | 9,000, | **99**, 3202. |
| Total, | 31,000 | |

**Commerce.**

In 1894 the navigable importance of the river under improvement was liable to decrease on account of the construction and operation of a railroad between Coquille City and Myrtle Point, **94**, 2559.

Boats being built, 1900, for the shallow navigation of the stream, **1900**, 4273.

**Contracts.**

**1897.** Noble & Saunders, dredging, constructing dikes, etc.; piles, 12½ cents per l. f.; lumber, $12.50 per M. f.; ironwork, 7½ cents per pound; brush, $2.25 per cord; stone, $1 per ton; sand excavation, 10 and 15 cents per c. y.; snagging, $20 per day ($14,295), **97**, 3384.

**Engineers.**

Chief of Engineers. Reports, **93**, 438; **94**, 403; **95**, 442; **96**, 394; **97**, 496; **98**, 481; **99**, 565; **1900**, 4271.

Engineers in Charge.

Capt. T. W. Symons, 1893–95. Reports, **93**, 3329; **94**, 2558; **95**, 3348.

Capt. W. L. Fisk, 1896–98. Reports, **96**, 3231; **97**, 3383; (Maj.) **98**, 2961.

Capt. W. W. Harts, 1899–. Reports, **99**, 3202; **1900**, 4271.

Assistants.

D. B. Ogden. Report, **95**, 3351.

R. S. Littlefield. Report, **95**, 3355.

**Operations.**

**1892–93.** About 1,000 snags removed and 200 f. of wing dam built, **93**, 3330.

**1894–95.** About 400 snags removed and about 500 f. of wing dam built, **95**, 3350.

**1895–96.** A few obstructions removed, **96**, 3232.

**1896–97.** Some snagging done, **97**, 3383.

**1897–98.** 3,700 f. of pile and brush dikes built; 2,200 l. f. pile, brush, and lumber shore protection built, and some dredging done, **98**, 2962.

**1899–1900.** About 300 snags, etc., removed; over 8,000 c. y. dredged, **1900**, 4271.

**Physical characteristics.**

Description of, **93**, 3329; **95**, 3350.

In 1893 navigation was obstructed between Coquille City and Myrtle Point by snags and other obstructions, **93**, 3329.

Condition of stream between Rackliffs Landing and Myrtle Point worse each year. Wing dams to remove sediment of but little benefit. **1900**, 4273.

**Projects.**

By Capt. Symons, 1892–93, removal of bad snags obstructing navigation and tending to form bars; contraction of river into a channel 50 f. wide where shoals have formed in order to scour out desired depth; estimate, $26,000, **93**, 3329.

By Maj. Symons, 1895, for revising project so as to provide for confining the waters of the river between pile dikes about 60 f. apart, or between a pile dike and a strongly revetted shore; for dredging a channel 50 f. wide and 4 f. deep at low water and depositing the dredged material behind the pile dikes; and for the construction of wing dams below Roberts Landing to scour out the shoals at that point; cost, $43,176.48, **95**, 3350.

**Surveys.**

Survey made, 1894, under the direction of Capt. Symons, **95**, 3350.

Maps. **95**, 3356.

Photographs. **99**, 4272.

## CORE SOUND, N. C.[a] (See *Norfolk Harbor, etc.*)

**Commerce.**

Principally in fish, oysters, clams, etc., to Beaufort and Newbern, **93**, 1375.

**Engineers.**

Chief of Engineers. Report, **95**, 191, **1900**, 265, 277.

Engineer in Charge. Maj. W. S. Stanton, 1892–95. Report, **95**, 1373.

**Physical characteristics.**

The sound is 25 miles long between Pamlico Sound on the northeast and the "Straits" on the southwest, **95**, 1374.

Description of, **95**, 1374.

**Projects.**

After survey of 1837, it was estimated that $55,000 would be required for improvement. H. Doc. 482, 55th Cong., 2d sess.

**Surveys.**

Survey made in 1837. H. Doc., 482, 55th Cong., 2d sess.

Examination ordered by act of Aug. 17, 1894, made, 1895, by Maj. Stanton (report unfavorable), **95**, 1373.

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[a] Survey.—Report Jan. 6, 1837; estimate, $55,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

### CORNAY BAYOU, LA. (See *D'Arbonne Bayou.*)

### CORNAY RIVER. (See *D'Arbonne Bayou, La.*)

### CORNELLS CREEK AND LANDING TO JAMAICA BAY, N. Y.
WATER CONNECTION.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 85; **81**, 108.

ENGINEER IN CHARGE. Col. J. Newton. Report, **81**, 671.

ASSISTANT. R. H. Talcott. Report, **81**, 672.

**Plans.**

By Col. Newton, 1880, dredging channel 60 to 70 f. wide, with a depth of 2 f. at m. l. w., from Jamaica Bay to Cornells Landing. Estimate, $29,900. **81**, 673.

**Surveys.**

Ordered by act of June 14, 1880; made, 1881, under the direction of Col. Newton, **81**, 671.

### CORNWALL HARBOR, N. Y. (See *Hudson River.*)

### CORPUS CHRISTI, TEX.[a] (See *Aransas Pass, Tex.*)

### CORPUS CHRISTI RIVER. (See *Sabine River, etc.*)

### CORSICA CREEK, MD.

**Appropriations.**

1882, $5,000, **82**, 842
1884, 5,000, **84**, 892
1886, 10,000, **86**, 867
1888, 10,000, **88**, 747

Total, 30,000

**Commerce.**

Important, **86**, 868.

**Contracts.**

**1883.** American Dredging Co., dredging, 18 cents per c. y., **84**, 891.

**1884.** Baltimore Dredging Co., dredging, 13 cents per c. y., **85**, 884.

**1886.** National Dredging Co., dredging, 11 cents per c. y., **87**, 839, 840.

**1889.** Baltimore Dredging Co., dredging, 12½ cents per c. y., **89**, 900.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 150; **82**, 129; **83**, 134; **84**, 141; **85**, 133; **86**, 131; **87**, 93; **88**, 92; **89**, 109; **90**, 100.

ENGINEERS IN CHARGE.

Lt. Col. W. P. Craighill, 1881–84. Reports, **82**, 842; **83**, 668; **84**, 891.

Maj. W. H. Heuer, 1884. Report, **85**, 867.

W. F. Smith, U. S. agent, 1884–90. Reports, **85**, 884; **86**, 867; **87**, 838; **88**, 747; (Maj.) **89**, 899; **90**, 937.

**Operations.**

**1883–84.** 23,514 c. y. dredged near Centerville, **84**, 891.

**1884–85.** 24,569 c. y. dredged to extend previous work, **85**, 884.

**1886–87.** 77,390 c. y. dredged from channel and turning basin, **87**, 839.

**Private work.**

Dredging, **87**, 839.

**Projects.**

By Lt. Col. Craighill, 1882, for channel, Hooper's Landing to Centerville, 100 f. wide and 8 f. deep at m. l. w.; also a turning basin at Centerville 200 by 300 f. Estimate, $30,000, **82**, 842.

**Surveys.**

Ordered by act of Mar. 3, 1881, made under the direction of Col. Craighill, 1881, **82**, 842.

MAPS. **87**, 838.

### CORSICA SHOAL, ST. CLAIR RIVER, MICH.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 363.

ENGINEER IN CHARGE. Col. O. M. Poe, 1890. Report, **91**, 2820, 2821.

**Physical characteristics.**

Description of, **91**, 2821.

**Plans.**

By Col. Poe, 1891, for a channel 21 feet deep through Corsica Shoal near the entrance to the St. Clair River, estimate $410,666, **91**, 2822.

**Survey.**

Examination ordered by act of September 19, 1890, made, 1891, under direction af Col. Poe, **91**, 2820.

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[a] Survey.—Report Apr. 18, 1858; estimate, $11,739. (H. Doc. No. 482, 55th Cong,, 2d sess.)

## CORSONS SOUND, N. J. (See *Townsends Inlet.*)

## CORVALLIS CITY. (See *Willamette River, Oreg.*)

## COSCOB AND MIAMUS RIVER, CONN.

**Appropriations.**

1892, $7,000, **93**, 959.
1894, 4,000, **95**, 817.
1896, 8,000, **96**, 723.

Total, 19,000

**Contracts.**

**1892.** A. J. Beardsley, dredging, 15 cents per c. y., s. m. ($4,500), **93**, 959.

**1895.** G. B. Beardsley, dredging, 9.3 cents per c. y., s. m. ($3,000), **95**, 818.

**1896.** W. H. Taylor, jr., dredging, 9 cents per c. y. ($5,400), **97**, 969.

**1899**. Hartford Dredging Co., dredging, 18 cents per c. y ($1,170), **99**, 1,185.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 81; **93**, 84; **94**, 75; **95**, 85, 95; **96**, 82; **97**, 102; **98**, 108; **99**, 122; **1900**, 138.

ENGINEERS IN CHARGE. Col. D. C. Houston. Reports, **91**, 852, 855.

Lt. Col. H. M. Roberts, 1893–95. Reports, **93**, 958; **94**, 681; (Col.), **95**, 816, 881.

Maj. H. M. Adams, 1896. Report, **96**, 721.

Maj. S. S. Leach, 1897. Reports, **97**, 969; **98**, 972; **99**, 1,184; **1900**. 1349.

**Operations.**

**1892–93.** 23,953, c. y., s. m., dredged, **93**, 959.

**1893–94.** 16,047 c. y. dredged, **94**, 682.

**1895–96.** About 33,000 c. y. dredged, **96**, 722.

**1896–97.** 1,876 c. y. dredged, **97**, 969.

**1897–98**. 58,124 c. y. dredged, **98**, 972.

**1898–1900.** 6,500 c. y. dredged, **99**, 1184; **1900**, 1349.

**Physical characteristics.**

Description of, **91**, 854; **93**, 958; **96**, 721.

**Projects.**

By Col. Houston, in 1891, for dredging a channel 150 feet wide and 8 feet deep; estimate, $36,000, **91**, 855, **93**, 958. This was modified in 1896 to provide for a channel 6 feet deep and 150 feet wide to the railroad bridge and thence 100 feet wide to Miamus, with a turning basin, inner harbor entrance, 7 feet deep and 300 feet wide; total estimated, $54,000, **96**, 722.

**Surveys.**

Survey ordered by act of September 19, 1890, made, 1891, under direction of Col. Houston, **91**, 855.

Survey with a view to construction of a turning basin ordered by act of August 17, 1894, made by Col. Robert, in 1895 (see *Projects*), **95**, 881.

MAPS. **93**, 958; **95**, 882.

## COTTAGE CITY HARBOR, MASS.

**Commerce.**

Unimportant, **87**, 569; **1900**, 1294.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 43; **1900**, 111.

ENGINEERS IN CHARGE:

Lt. Col. G. H. Elliot, 1886. Report, **87**, 568.

Maj. D. W. Lockwood, 1900. Report, **1900**, 1293.

**Physical Characteristics.**

Description, **87**, 569; **1900**, 1294.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made 1886, under direction of Lt. Col. Elliot (report unfavorable), **87**, 569.

Examination ordered by act of March 3, 1899, made by Maj. Lockwood, 1899 (report unfavorable) **1900**, 1294.

## COTUIT HARBOR, MASS.

**Commerce.**

Description of, **1900**, 1289.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900**, 111.

ENGINEER IN CHARGE. Maj. D. W. Lockwood, 1900. Report, **1900**, 1287.

**Physical Characteristics.**

Description of; series of sandy bays opening into Nantucket Sound, with one or two openings. Cotuit entrance is about 8 miles southwesterly from Hyannis. **1900**, 1288.

**Surveys.**

Examination ordered by act of March 3, 1899, made, 1899, by Maj. Lockwood (report unfavorable) **1900**, 1288.

**COUNCIL BLUFFS, IOWA.** (See *Missouri River, between mouth and Sioux City, Iowa.*)

## COURTABLEAU BAYOU, LA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $7,500, | **80**, | 1160. |
| 1881, | 7,500, | **81**, | 1294. |
| 1884, | 4,000, | **84**, | 1279. |
| 1886, | 5,000, | **86**, | 1264. |
| 1888, | 5,000, | **88**, | 1256. |
| 1890, | 2,200, | **90**, | 1749. |
| 1894, | 5,000, | **95**, | 1762. |
| 1896, | 2,500, | **96**, | 1503. |
| 1899, | 20,000, | **99**, | 1847. |
| Total | 58,700 | | |

**Commerce.**

Benefit from work done, **83**, 1124.

**Contracts.**

Plant, old and unserviceable, sold by auction in 1893, **93**, 1821.

**1895.** F. Ottendorfer, hire of steamboat, $45.50 per day, **95**, 1762.

**1899.** J. E. Crusel, removing raft, $17,500, and constructing log boom, $585, **99**, 1848.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 145; **81**, 195; **82**, 191; **83**, 210: **84**, 213; **85**, 220; **86**, 218; **87**, 184; **88**, 170; **89**, 198; **90**, 179; **91**, 225; **92**, 219; **93**, 244; **94**, 225; **95**, 251; **96**, 219; **97**, 283; **98**, 274; **99**, 326; **1900**, 371.

ENGINEERS IN CHARGE:

Maj. C. W. Howell, 1879–81. Reports, **80**, 1160, 1169; **81**, 1293.

Maj. A. Stickney, 1881–84. Reports, **82**, 1380; **83**, 1121; **84**, 1277.

Capt. T. Turtle, 1884–85. Reports, **85**, 1403, 1405.

Maj. W. H. Heuer, 1885–87. Reports, **85**, 1403; **86**, 1263; **87**, 1375.

Capt. W. L. Fisk, 1888–91. Reports, **88**, 1254; **89**, 1491; **90**, 1747.

Maj. J. B. Quinn, 1891–99. Reports, **91**, 1826; **92**, 1500; **93**, 1821; **94**, 1365; **95**, 1760; **96**, 1501; **97**, 1762; **98**, 1474; **99**, 1847.

Maj. H. M. Adams, 1900. Report, **1900**, 2259.

ASSISTANTS:

H. C. Collins. Reports, **80**, 1170; **81**, 1294; **83**, 1122; **84**, 1278; **85**, 1404.

Lt. O. T. Crosby. Report, **87**, 1376.

**Operations.**

**1881–82.** Closure of run-out, Bayou Big Fordoche, by brush, timber, and clay dam, built by hired labor; also choking other run-out bayous by felled trees, **82**, 1381.

**1882–83.** Closure of run-out, Bayou Little Fordoche, with dam, built by hired labor; depth of water on Little Devil Bar increased 3 f., **83**, 210, 1123.

**1884–85.** Construction of quarter boat and flat boat with pile driver attached, **85**, 1403.

**1885–86.** Dams at Little and Big Fordoche rebuilt by hired labor, **86**, 1263.

**1886–87.** Dams in progress at outlets of Bayou English, and repairs made to other dams, **87**, 1325.

**1887–88.** Repairs to old dams in the Big and Little Fordoche, and new dam begun in Bayou English, **88**, 1255.

**1889–90.** Broken dams in bayous Manizelle, English, and Fordoche repaired with sheet piling, **90**, 1749.

**1890–91.** Repairs to plant, **91**, 1827.

**1891–92.** Repairs to dams at Cane, Manizelle, and Big Fordoche bayous, **92**, 1501.

**1895–96.** Several bayous closed and efforts made to clear obstructing raft of logs from the stream, **96**, 1502.

**1899–1900.** Log boom constructed and raft removed, **1900**, 2259.

**Physical characteristics.**

Description of, **80**, 1170; **81**, 1295; **93**, 1821.

Little Devil Bar, at the entrance to the bayou, an obstruction to navigation, **95**, 1762.

In 1896 the channel was obstructed and traffic completely blocked by a raft of logs that came in from the Atchafalaya, **96**, 1502; **97**, 1762.

**Projects.**

By Maj. Howell, 1880, to improve low-water navigation, Port Barre to Atchafalaya, by removal of obstructions, closing run-out bayous, and construction of a needle dam and lock 4 miles above Port Barre; estimate, $40,000, **80**, 1160.

In 1883 Maj. Stickney increased the previous estimate by $38,500, to provide for masonry lock walls instead of timber construction previously proposed, **83**, 1122, 1124; **85**, 1403.

In 1884 Capt. Turtle proposed that all other work be held in abeyance until the bayous on the south side of Bayou Courtableau were closed; estimate, $16,000, **85**, 1404, 1406; **86**, 219.

By Maj. Quinn, 1894, for repair of dams across several bayous and, if funds permitted, the closing of several small bayous, **95**, 1762.

By Maj. Quinn, 1899, to place a floating log boom across the mouth of the bayou to prevent the entrance of drift from the Atchafalaya, and to remove the raft so as to restore navigation, **99**, 1847.

**Surveys.**

Examination ordered by act of Mar. 3, 1879, **80**, 145, 1169; made under direction of Maj. Howell, 1880, **79**, 112; **80**, 1169.

Survey by H. C. Collins, 1880, **81**, 1293.

## COWESSETT BAY, R. I. (See *Apponaug Harbor.*)

## COWLES CREEK, OHIO.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 328.

ENGINEER IN CHARGE. Maj. L. C. Overman, 1888. Report, **89**, 2335.

**Physical characteristics.**

Description of, **89**, 2335.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Overman (report unfavorable) **89**, 2335.

## COWLITZ RIVER, WASH.

**Appropriations.**

1880, $2,000, **81**, 2601.
1881, 1,000, **81**, 2601.
1882, 1,000, **82**, 2685.
1884, 2,000, **84**, 2273.
1886, 2,000, **86**, 1952.
1888, 3,000, **88**, 2190.
1890, 8,000, **90**, 3064.
1892, 3,000, **92**, 2838.
1894, 3,000, **95**, 3595.
1896, 3,000, **96**, 3385.
1899, 3,000, **99**, 3249.

Total, 31,000

**Commerce.**

Important, **81**, 2600.

Large, 1900, compared with the cost of annual maintenance, **1900**, 4366.

**Contracts.**

**1884.** J. Kellogg & Co., construction of 300 feet of wing-dam, **85**, 2439.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 241, 242; **81**, 331; **82**, 323; **83**, 336; **84**, 339; **85**, 371; **86**, 359; **87**, 333; **88**, 306; **89**, 364; **90**, 329; **91**, 418; **92**, 392; **93**, 456; **94**, 417; **95**, 466; **96**, 415; **97**, 520; **98**, 508; **99**, 597; **1900**, 674.

ENGINEERS IN CHARGE:

Maj. G. L. Gillespie, 1879–82. Reports, **80**, 2331; **81**, 2600.

Capt. C. F. Powell, 1882–85. Reports, **82**, 2684; **83**, 2073; **84**, 2272.

Maj. W. A. Jones, 1885–90. Reports, **85**, 2439; **86**, 1952; **87**, 2524; **88**, 2190; **89**, 2589.

Maj. T. H. Handbury, 1890–93. Reports, **90**, 3063; **91**, 3370; **92**, 2837; **93**, 3526.

Maj. J. C. Post, 1894–95. Reports, **94**, 2662; **95**, 3594.

Capt. H. Taylor, 1896–97. Reports, **96**, 3385; **97**, 3463.

Maj. W. L. Fisk, 1898–99. Reports, **98**, 3041; **99**, 597.

Capt. W. C. Langfitt, 1899.

Capt. W. W. Harts, 1899. Report, **1900**, 4366.

ASSISTANT. R. A. Habersham. Reports, **80**, 2232; **81**, 2601.

**Operations.**

**1880–81.** 40 miles of river cleared by removal of snags and trees, **81**, 2600.

**1881–82.** 304 snags and trees removed, **82**, 2684.

**1882–83.** 483 logs, snags, and trees removed, **83**, 2073.

**1884–85.** 300 l. f. wing-dam built, by contract, **85**, 2439.

**1886–87.** 190 l. f. wing-dams built; 315 snags removed, **87**, 2525.

**1888–89.** 280 snags, 9 log jams, rock and gravel cleared from the channel; 250 l. f. of wing-dams built, **89**, 2590.

**1890–91.** 1,200 c. y. of gravel and 156 logs, snags, and trees removed from channel between the mouth and Toledo, **91**, 3370.

**1891–92.** 50 snags cleared from the channel, and 400 l. f. of wing dam built at Toutle River Pass, **92**, 2838.

**1892–93.** 1,094 l. f. wingdams built, and about 150 snags, etc., removed, **93**, 3526.

**1893–94.** Over 100 snags, etc., removed, **94**, 2662.

**1894–95.** Over 100 snags, etc., removed, a large rock removed, and 2,000 l. f. bank revetment built, **95**, 3594.

**1895–96.** About 500 snags, etc., removed, and bank revetment repaired, **96**, 3386.

**1896–97.** About 150 snags, etc., removed, and bank revetment repaired, **97**, 3463, 3464.

**1897–98.** Snagging done, and a small wing dam built, **98**, 3041.

**1899–1900.** Closing dam opposite Toledo built, and one under construction below Toledo; river thoroughly snagged for 20 miles, **1900**, 4366.

**Physical characteristics.**

Results of works of improvement, **93**, 3526; **98**, 3041.

Channels changed by freshets in 1896 and 1897, **97**, 3464; **98**, 3041.

High stages damaging works, **1900**, 4366.

**Projects.**

By Maj. Gillespie, 1879, mouth to Cowlitz Landing, removing snags and scraping

## COWLITZ RIVER, WASH.—Continued.

bars, estimate, $5,000 for the first year, with an annual expenditure thereafter of $2,000, **81**, 2603; **86**, 1952; **91**, 3371.

Capt. Hart estimated, 1900, that $2,000 would be required annually for maintenance, **1900**, 4366.

**Surveys.**

Ordered by act of Mar. 3, 1879, made under direction of Maj. Gillespie, 1879, **80**, 2331.

Minor surveys, **97**, 3464; **1900**, 4366.

## COXSACKIE. (See *Hudson River.*)

## CRANBERRY INLET, N. J.[a] (See *Barnegat Bay.*)

**Appropriations.** (See *Surveys.*)

**Engineers.**

ENGINEER IN CHARGE. Col. J. D. Graham, 1865. Report, **66**, 37.

**Surveys.**

$1,000 appropriated for survey by act approved Aug. 30, 1852.

## CRANE AND WATERS RIVERS, MASS.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 44; **90**, 38.

ENGINEER IN CHARGE. Lt. Col. S. M. Mansfield, 1888. Report, **90**, 517.

ASSISTANT. T. T. H. Harwood. Report, **90**, 519.

**Physical characteristics.**

Description of, **90**, 517.

**Plans.**

By Lt. Col. Mansfield, 1889; improvement of Waters River by enlarging the existing low-water channel to a width of 100 f. and a depth of 8 f. at m. l. w. from deep water of Essex Branch to the wharves at the head of navigation; estimate, $14,000. Improvement of Crane River by excavation of a channel 2,850 f. long, 100 f. wide, and 8 f. deep at m. l. w.; estimate $30,000. **90**, 518, 519.

**Survey.**

Ordered by act of Aug. 11, 1888, made, made, 1889, under direction of Lt. Col. Mansfield, **90**, 517

## CRANES CREEK, VA.

**Commerce.**

If creek were improved it was estimated in 1894–95 that there would be an annual commerce of about 51,000 tons, **95**, 1274.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 146; **95**, 167.

ENGINEERS IN CHARGE:

Lt. Col. P. C. Hains, 1891. Report, **91**, 1289.

Maj. C. E. L. B. Davis, 1892–95. Report, **95**, 1271.

**Physical characteristics.**

Description of, **91**, 1289; **95**, 1272.

**Projects.**

Maj. Davis, 1895, submitted two plans of improvement; estimates, $56,040 and $29,160, respectively, **95**, 1274.

**Surveys.**

Examination made, 1891, under direction of Lt. Col. Hains (report unfavorable), **91**, 1289.

Survey of the mouth ordered by act of Aug. 17, 1894, made, 1895, by Maj. Davis (report unfavorable; see *Projects*), **95**, 1271.

## CRAWFISH CREEK. (See *Ohio River.*)

## CREEL BAY, TOTTEN BAY, AND MINNEWAUKEN SHOALS, IN DEVILS LAKE, N. DAK.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 274, 2223.

ENGINEER IN CHARGE. Maj. W. A. Jones, 1891. Report, **91**, 2223.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Jones (report unfavorable), **91**, 2223.

[a] Survey—Report Oct. —, 1853; estimate, $50,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## CRESCENT CITY, CAL. (See also *Pacific coast, harbor of refuge.*)

**Commerce.**
Description of, **93**, 3311.
In 1891 the freight on seagoing shipments amounted probably to $60,000, **93**, 3313.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **67**, 51; **77**, 123; **78**, 136; **79**, 180; **87**, 324; **93**, 432; **95**, 441; **1900**, 634.

BOARD OF ENGINEERS. Of the Pacific coast met August, 1876, to "examine the harbors of Mendocino, Humboldt Bay, Trinidad, and Crescent City, Cal., with a view of establishing a breakwater and harbor of refuge." The board did not consider it well adapted for a harbor of refuge. Report **77**, 1053. (Lt. Cols. Williamson, Alexander, and Stewart, and Maj. Mendell.)

ENGINEERS IN CHARGE:
Maj. R. S. Williamson. Report, **67**, 515.
Lt. Col. B. S. Alexander. Report, **79**, 1785.
Capt. A. H. Payson, 1887. Report, **87**, 2454.
Maj. W. H. Heuer, 1893–95. Reports, **93**, 3308; **95**, 3339.
Capt. W. W. Harts, 1899. Report, **1900**, 4262.

ASSISTANT. Lt. W. H. Heuer. Report, **67**, 517.

**Estimates.** (See *Plans* and *Projects.*)
By Lt. W. H. Heuer, breakwater, $2,178,008, **67**, 518.
By Board of Engineers, breakwater, $6,022,940, **77**, 1059.

**Physical characteristics.**
Description of, **93**, 3310; description of rocks at the entrance to the harbor, **95**, 3340.

A town situated on the ocean beach, and the only shipping port at which seagoing vessels touch in Del Norte County. The bay is an open roadstead, very contracted, being little more than 1½ miles in extent east and west, and ¾ of a mile north and south. **93**, 3311.

**Plans.** (See *Estimates* and *Projects.*)
By Lt. W. H. Heuer, breakwater of stone, 3,767 f. in length, **67**, 518. Compared with European breakwaters, **67**, 516.
By Board of Engineers, breakwater, **77**, 1059.

**Projects.** (See *Estimates* and *Plans.*)
In 1895 Maj. Heuer estimated it would cost $285,000 to remove the rocks in the entrance to the harbor, **95**, 3341.

**Surveys.**
Included in the Coast Survey, **67**, 517.
Examination by Board of Engineers, **77**, 1053.
Examination ordered by act of June 18, 1878, assigned to Lt. Col. Alexander, **78**, 136. Report, **79**, 1785.
Examination of harbor with a view to a sea wall from Battery Point to Flat Rock, ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Payson (report unfavorable), **87**, 2454.
Examination ordered by act of July 13, 1892, made in the same year by Maj. Heuer (report unfavorable), **93**, 3309.
Survey ordered by act of Aug. 17, 1894, made in 1895 by Maj. Heuer (report unfavorable; see *Projects*), **95**, 3339.
Examination of Crescent Bay was ordered by act of Mar. 3, 1899. Report (unfavorable) on Crescent City Harbor was submitted by Maj. Harts, 1899. **1900**, 4262.

## CRISFIELD HARBOR, MD.

**Appropriation.**
1875, $37,317.50, **75**, 88, ii, 71; **76**, 64, 290.

**Contracts.**
**1875.** G. H. Ferris, dredging, 13⅝ cents per c. y., **75**, ii, 71; **76**, 64, 290.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **75**, 87, 90; **76**, 64.

ENGINEER IN CHARGE. Maj. W. P. Craighill, 1874–76. Reports, **75**, ii, 71, 105; **76**, 290.

ASSISTANTS.
C. Humphreys, **75**, ii, 106.
H. Bacon, in immediate charge, 1875. Report, **75**, ii, 106.
Capt. C. B. Phillips, **76**, 290.

**Operations.**
**1874–75.** Dredging, by contract, 36,195 c. y., **75**, 88, ii, 71.
**1875–76.** Removing 202,194 c. y. by dredging, completing the work. **76**, 64, 290.

**Physical characteristics.**
Described, **75**, ii, 106.

**Projects.**
By H. Bacon, adopted by Maj. Craighill, for a 12-f. channel of uniform width of 150 f., 67,200 c. y. excavation, $20,405; for channel 400 f. to 300 f. and 150 f. in width, 128,700 c. y. excavation, $37,317.50, **75**, ii, 105, 107; **76**, 290. Completed, **76**, 64, 290.

**Surveys.**
Examination by Maj. Craighill, 1874, and survey, under his direction, by H. Bacon. Reports, **75**, ii, 105.

## CROATAN SOUND. (See *Chesapeake Bay.*)

## CROATAN SOUND, N. C. (See *Albemarle Sound to Atlantic Ocean, N. C.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **66**, 7.

## CROOKED RIVER, FLA. (See *Carrabelle bar and harbor.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 189; **82**, 180.

ENGINEER IN CHARGE. Capt. A. N. Damrell. Report, **82**, 1314.

**Plans.**

By Capt. Damrell, 1882, for dredging the channel over the bar and a short distance above to a depth of 13 ft. Estimate, $72,000. **82**, 1314.

**Survey.**

Examination ordered by act of Mar. 3, 1881, made under direction of Capt. Damrell, **82**, 1314.

## CROOKED RIVER, WASH. (including Skamakawa River). (See *Deep River.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 420.

ENGINEER IN CHARGE. Maj. T. H. Handbury, 1890. Report, **91**, 3378.

**Physical characteristics.**

Description of, **91**, 3378.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Handbury (report unfavorable) **91**, 3378.

## CROSSOVER LIGHT. (See *St. Lawrence River, N. Y.*)

## CROSS VILLAGE HARBOR, MICH. (Harbor of Refuge.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 301; **85**, 332.

ENGINEERS IN CHARGE:

Maj. D. P. Heap. Report, **84**, 1995.

Capt. D. W. Lockwood. Report, **84**, 1996.

Lt. Col. O. M. Poe. Report, **85**, 2185.

ASSISTANTS:

J. A. Mitchell. Report, **84**, 1997.

O. B. Wheeler. Report, **85**, 2185.

**Physical characteristics.**

Locality described, **84**, 1995, 1997; **85**, 2185.

**Plans.**

A sheltered area of 20 acres would cost $300,000. **84**, 1997, 1998.

**Surveys.**

Examinations ordered by acts of Aug. 2, 1882, and July 5, 1884, made under the directions of Maj. Heap, Capt. Lockwood, and Col. Poe (reports unfavorable), **84**, 1995, 1996; **85**, 2185.

## CROW SHOALS, DELAWARE BAY, N. J. (See *Delaware Bay.*)

**Plans.**

Proposed by Lt. Col. Kurtz, to establish a harbor of refuge with the following works: 1st, a solid breakwater along the shoal; 2d, opening the channel of approach by dredging; 3d, ice piers across the upper end of the harbor, $10,477,520, **74**, ii, 147.

**Surveys.**

For an artificial harbor or breakwater ordered by act approved Mar. 3, 1873, assigned to Lt. Col. Kurtz, **74**, 93; and made under his direction by F. M. Eppley in Aug., 1873. Reports, **74**, ii, 146–154.

## CRYSTAL RIVER, FLA.

**Commerce.**

In 1894 most of the freight was carried by the railroads, **95**, 1577.

In 1897 commerce had increased and there was a probability that it would still increase if a channel were made through the bar at the entrance to the river, **97**, 1581.

Description of, **1900**, 2080.

Estimated imports and exports for 1900, with deep water to Gulf, $2,257,550, **1900**, 2080.

## CRYSTAL RIVER, FLA.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 189; **82**, 185; **89**, 1355; **95**, 222; **97**, 252; **99**, 288; **1900**, 327.

ENGINEERS IN CHARGE:

Capt. A. N. Damrell. Report, **82**, 1316.

Capt. W. M. Black, 1888. Report, **89**, 1355.

Maj. T. H. Handbury, 1895. Report, **95**, 1576.

Lt. Col. W. H. H. Benyaurd, 1897. Report, **97**, 1580.

Capt. H. Jervey, 1900. Report, **1900**, 2074.

Capt. T. H. Rees, 1900. Report, **1900**, 2078.

ASSISTANTS:

P. Robinson. Report, **82**, 1317.

Lt. D. D. Gaillard. Report, **89**, 1356.

Lt. J. J. Meyler. Report, **97**, 1581.

J. W. Sackett. Report, **95**, 1577.

W. H. Caldwell. Reports, **1900**, 2077, 2080.

T. B. Bird. Report, **1900**, 2082.

**Physical characteristics.**

Description of, **89**, 1355; **95**, 1576; **1900**, 2075.

A broad, clear stream on the west coast of Florida, about 25 miles to the southeast of Cedar Keys, having an ample depth of water except near the village of Crystal River, **95**, 1576.

**Plans.** (See *Projects.*)

For dredging and blasting a chanel 6 f. deep through the shoals at the mouth; estimate, $115,000, **82**, 1317.

In 1889 Capt. Black reported the available channel depth sufficient for existing commercial requirements, **89**, 1355.

**Projects.** (See *Plans.*)

Capt. Rees submitted, 1900, plans for three routes, with estimates of cost, viz, $84,647.46, $77,929.47, and $54,190.75, giving preference to the first route, via a straight line from deep water of the Gulf to the river's mouth, **1900**, 2079.

**Surveys.**

Examination ordered by act of Mar. 3, 1881, made under direction of Capt. Damrell, **82**, 1316.

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Black, **89**, 1355.

Examination ordered by act of Aug. 17, 1894, made under the direction of Maj. Handbury, 1894 (report unfavorable), **95**, 1577.

Examination ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd, 1896 (report favorable), **97**, 1581.

Examination and survey of Crystal River, Fla., from the town of Crystal River to its entrance in the Gulf of Mexico, ordered by act of Mar. 3, 1899; examination made, 1899, under direction of Capt. Jervey (report favorable); survey made, 1900, under direction of Capt. Jervey, report by Capt. Rees (favorable; see *Projects*), **1900**, 2075, 2078.

## CUIVRE RIVER, MO.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $2,000, | **80**, | 1550. |
| 1881, | 5,000, | **81**, | 1730. |
| 1882, | 5,000, | **82**, | 1793. |
| Total, | 12,000 | | |

**Commerce.**

Unimportant, **72**, 393. Large quantities of coal and iron, **72**, 392.

**Contracts.**

**1881.** H. S. Brown & Co., dredging, 25 and 20 cents per c. y., **81**, 1729.

**1882.** H. S. Brown & Co., dredging, 22½ cents per c. y., **83**, 1429.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 59; **72**, 56; **79**, 133; **80**, 176, 177; **81**, 237; **82**, 235; **83**, 242.

ENGINEERS IN CHARGE:

Lt. Col. W. F. Raynolds, 1872. Report, **72**, 390.

Maj. A. Mackenzie, 1879–83. Reports, **80**, 1549, 1550; **81**, 1729; **82**, 1793; **83**, 1429.

ASSISTANTS:

A. H. Blaisdell, **72**, 391.

C. W. Durham. Report, **80**, 1551.

**Operations.**

**1880–81.** 19,319 c. y. dredged; 13,609 snags and trees removed and felled, **81**, 1729.

**1882–83.** 20,000 c. y. dredged; snags and trees removed, **83**, 1429.

**Physical characteristics.**

General, **72**, 390; obstructions, **80**, 1552.

**Plans.** (See *Projects.*)

By A. H. Blaisdell, 1872, for improving river, mouth to Big Creek, 4-f. channel, $48,292.50; 6-f. channel, $80,736. To Big Creek Bar, not including the removal of said bar, 4-f. channel, $14,615; 6-f. channel, $20,671. To within ¼ mile of Big Creek, 4-f. channel, $33,677.50; 6-f. channel, $60,065. **72**, 395.

## CUIVRE RIVER, MO.—Continued.

**Projects.** (See *Plans.*)

By Capt. Mackenzie, 1879, for dredging channel from 80 to 100 f. wide and 2 f. deep, l. w., through the shoals; brush and rock dam across lower part of Cuivre Slough, and removing snags, wrecks, and obstructions; estimate, $30,000, **80**, 1553.

**Surveys.**

Ordered by act approved Mar. 3, 1871, assigned to Lt. Col. Raynolds, and made under his direction by A. H. Blaisdell. Report, **72**, 391.

Ordered by act approved Mar. 3, 1879, assigned to Capt. Mackenzie, **79**, 133.

Ordered by act of Mar. 3, 1879, made, 1879, under direction of Capt. Mackenzie, **80**, 1550.

## CUMBERLAND, MD. (See *Bowmans River.*)

## CUMBERLAND RIVER, KY. AND TENN.

| Parts. | Appropriations. |
|---|---|
| A.—Cumberland River (See parts B, C, and D) | [a]$491,000 |
| B.—Above Nashville (See part A) | 1,890,000 |
| C.—Below Nashville (See part A) | 370,000 |
| D.—South Fork (See part A) | 12,000 |
| Total | 2,763,000 |

### Part A.—Cumberland River.

**Appropriations.**

1832, $30,000, act, July 7.
1834, 30,000, act, June 28.
1836, 20,000, act, July 7.
1837, 55,000, act, Mar. 3.
1838, [b]20,000, act, July 7.
1871, [b]30,000, **71**, 62, 467; **72**, 462; **74**, 578.
1872, [b]20,000, **72**, 58, 462; **74**, 578.
1873, [b]25,000, **73**, 62, 548; **74**, 578.
1875, [b]25,000, **75**, 76, 790.
1876, [c]15,000, **77**, 90, 593, 596.
1876, [e]25,000, **77**, 90, 595, 596.
1876, [f]2,000, **77**, 90, 596.
1876, [d]10,000, **77**, 90, 594, 596.
1878, [b]45,000, **78**, 103, 759.
1878, [c]20,000, **78**, 103, 760.
1878, [d]8,000, **78**, 103, 760.
1878, [e]30,000, **78**. 103, 761.
1878, [f]2,000, **78**, 104, 761.
1879, [b]40,000, **79**, 139, 1265.
1879, [c]18,000, **79**, 139, 1266.
1879, [d]6,000, **79**, 139, 1266.
1879, [e]15,000, **79**, 139, 1267.

Total, 491,000

**Commerce.**

Justification of improvement and importance of river, **71**, 468, 480, 485; **74**, 70, 578, 579; **75**, 791; **77**, 596.

Transit of coal barges on upper river by "coal tides," **71** 470, 471; **75**, 795, 798.

Necessity of increased facilities for commerce, **75**, 795, 798; **77**, 594.

Duration of navigable stages, **71**, 478; **75**, 795; **77**, 597.

Obstructions to navigation, list of, **71**, 470.

Coal transportation, cost of, **71**, 482; **75**, 798.

Coal and iron mines, description of, **71**, 481.

Projects, 1877, designed to improve downstream navigation on upper river alone, **75**, 790, 795; **77**, 595; **79**, 1266.

Improved condition of river, **79**, 1266.

**Contracts.**

Advantages of hired labor over contract work, **74**, 578.

**1871.** J. H. Maddox, removal of obstructions, rock excavation, construction of wing-dams, and dredging, **71**, 467, 468; death of, October, 1871, contract annulled, **73**, 547.

**1872.** P. L. Dewes, rock excavation, construction of wing-dams, and dredging, **73**, 547; extended to 1874; reextended to January, 1875, **74**, 577; completed August, 1874, **75**, 76, 790; all work done thereafter by hired labor.

**Engineers.**

CHIEF OF ENGINEERS. Reports **71**, 62; **72**, 58, 59; **73**, 62; **74**, 70; **75**, 76; **76**, 86; **77**, 89; **78**, 103; **79**, 138.

ENGINEERS IN CHARGE.

Maj. G. Weitzel, 1870–73. Reports, **71**, 467, 490; **72**, 462, 463.

Maj. W. McFarland, 1873–76; **73**, 61, 547. Reports, **73**, 547; **74**, 577; **75**, 790, 795.

Capt. W. R. King, 1876; **76**, 86. Reports, **76**, 714; **77**, 592; **78**, 759; **79**, 1264, 1279.

ASSISTANTS.

S. T. Abert, **71**, 468. Report, **71**, 469.

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[a] $151,000 for above Nashville, and $340,000 for below Nashville.
[b] Below Nashville.
[c] Nashville to Kentucky State line.
[d] State line to Smith's Shoals.
[e] At Smith's Shoals.
[f] Smith's Shoals to Falls of Cumberland.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part A.—Cumberland River—Continued.

E. Mead, **71**, 469.
F. Hellner, **71**, 469.
Capt. L. C. Overman, **74**, 577; **75**, 74. Reports, **76**, 714; **77**, 596.
R. C. McCalla. Report, **75**, 796.
F. R. Leavitt, **75**, 799.
S. Whinery. Report, **79**, 1280.

**Estimates.** (See *Plans* and *Projects.*)

Preliminary, of S. T. Abert, 1871. Upper river: Laurel to Point Burnside, 35 miles, $40,116, **71**, 479; Point Burnside to Nashville, 358 miles, $163,724, **71**, 479. Lower river: Nashville to mouth, 192 miles, $248,821, **71**, 480; **72**, 462; **78**, 759.

Final, of S. T. Abert, 1872. Laurel to Point Burnside, $41,000, **72**, 471; **77**, 596. Point Burnside to Nashville, $194,331, **72**, 471; **77**, 596. Aggregate increased by Maj. Weitzel to $258,864, **72**, 472; **74**, 578.

Assistant McCalla, 1875, Smith's Shoals, upper river, wing-dams, $52,044, **75**, 798. Increased by Maj. McFarland to $70,000, **75**, 796; **77**, 596. Increased by Capt. King to $100,000, **79**, 139, 1265.

Maj. Weitzel, 1872, upper river locks and dams, $4,000,000, **72**, 472; **75**, 795.

Capt. King, 1877, Smith's Shoals locks and dams, to cost, in all probability, more than $1,000,000, **77**, 595.

S. Whinery, 1879, passage of Cumberland Falls by locks and canal at cost of $368,500, **79**, 1281.

**Obstructions.** (See *Commerce; Private work.*)

**Operations.**[a]

**1871–72.** Removal of obstructions from river at Nashville, Nashville Island, and Gowers Island; 1,100 c. y. dredged, and 7,580 c. y. of wing dam built at Flax Patch; 300 c. y. of rock removed from Harpeth Shoals, **72**, 58, 462.

**1872–73.** At Sycamore Creek, 789 c. y. of wing dam were built; 141 c. y. of rock and 346 c. y. of gravel removed from channels between Sycamore Creek and Harpeth River, **73**, 547.

**1873–74.** Delay of contractor at Harpeth Shoals followed by use of hired labor independent of contract; 12,000 c. y. of stone for wing dams at, quarried, **74**, 577.

**1874–75.** 500 c. y. of rock removed from channel at Harpeth Shoals and Reeds Reef; 10,265 c. y. of stone placed in wing dams at, **75**, 76, 790. All operations after Aug., 1874, carried on by hired labor, **77**, 90, 592.

**1875–76.** At Harpeth Shoals 4,740 c. y. of wing dam were built, and 175 c. y. of rock removed from channel. At Davis Ripple 525 c. y. of wing dam were built, **76**, 714.

**1876–77.** At Harpeth Shoals 1,500 c. y. of wing dam were built, and 335 c. y. of rock removed. At Davis Ripple 1,625 c. y. of wing dam were built, **77**, 90, 593. At points above Nashville, i. e., Cub Creek, Sand, Smiths, Wild Goose, Hollimans Island Shoals, and Bartletts Bar, an aggregate of 16,440 c. y. of stone were quarried for wing dams; 530 c. y. of rock, 1,790 c. y. of gravel, and 36 logs and overhanging trees were removed from channels; 3,060 c. y. of stone placed in wing dams, **77**, 90, 593, 594, 595.

**1877–78.** No work below Nashville, **78**, 103, 759. Above Nashville 9,466 c. y. channel excavation of earth and rock; 441 trees and snags removed; 12,197 c. y. rock placed in wing dams; 2,147 c. y. rock quarried and ready for wing dams, **78**, 103, 759.

**1878–79.** 27,983 c. y. earth and rock removed from channels; 2,299 snags, logs, and overhanging trees removed; 33,625 c. y. rock placed in dams; 22,717 c. y. rock quarried for dams, **79**, 138, 1264.

**Physical characteristics.**

Description of river, **71**, 469, 483.

Canyon-like character of upper, **71**, 471.

Elevation of divide between Cumberland and Tennessee rivers, **71**, 469.

Distances between and elevation of points on river, **71**, 469; **72**, 465; **75**, 799.

Slope of water surface, **71**, 469, 473; **72**, 465.

Range of water surface, **71**, 470; **75**, 798; **76**, 714.

Discharge of river below Nashville, **71**, 475.

Character of river deposits **71**, 489.

Description of coal fields, **71**, 484; **75**, 799.

Description of Cumberland Falls, **79**, 1280.

**Plans.** (See *Estimates* and *Projects.*)

Maj. Weitzel, 1871, considers locks and dams the only feasible plan for improvement of low water above Nashville, **71**, 478, but its cost ($4,000,000) precludes adoption, **71**, 478; **72**, 472; **75**, 795; **77**, 595.

Capt. King, 1877, suggests use of wire rope on upper Cumberland to permit ascending boats to pass rapids during high water, **77**, 595.

S. Whinery, 1879, passage of Cumberland Falls by canals and locks; canal

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[a] Previous to Feb., 1877, confined to river below Nashville.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part A.—Cumberland River—Continued.

3,700 f. in length; locks 35 f. by 100 f.; total lift, 80 f.; estimate, $368,500, **79**, 128. Capt. King did not consider that requirements of commerce justified this improvement, **79**, 1279.

**Private (State and corporate) Work.**

Wing dams built by coal interest, **71**, 471, 475; by the State of Kentucky, **71**, 472.

Bridges crossing river between Nashville and mouth, **71**, 474.

**Projects.** (See *Estimates* and *Plans.*)

River divided into upper, Falls of the Cumberland to Nashville, 372 miles, and lower, Nashville to mouth, 192 miles, **71**, 469, 470; **72**, 465.

Maj. Weitzel, 1872, upper Cumberland, excavation of ledges, sand and gravel bars, concentration of water by wing dams, removal of snags and bowlders, restriction of tributaries to determined channels. On upper river the project is to lengthen the duration of present high-water navigation. On lower river to give a low-water depth about 3 f. **71**, 470, 478; **72**, 471; **77**, 594. Estimate, upper river improvement, $258,864, **72**, 472; **74**, 578; lower river improvement, $248,821, **71**, 480; **72**, 462.

R. C. McCalla, 1875, Smiths Shoals wing dams, consisting of timber cribs filled with stone, the dams to give descending coal boats a depth of 4 f. during medium high water. Estimate, $52,044. **75**, 795, 798. Revised by Maj. McFarland, **75**, 796. (See *Estimates.*)

**Surveys.**

Reconnoissance, 1870, from Falls of the Cumberland to Nashville, 403 miles, **71**, 469.

Survey from Nashville to mouth, 1870, 192 miles, **71**, 469.

Survey from Point Burnside to Nashville, 1871, 326.7 miles, **72**, 461, 465.

Special survey of Smith Shoals, 1874, **75**, 795.

Of Falls of Cumberland River, **79**, 142, 1279.

### Part B.—Cumberland River, above Nashville (497 miles).[a]

**Appropriations.**[b]

| | | |
|---|---|---|
| 1880, | [c] $15,000, | **80**, 1676. |
| | [d] 10,000, | **80**, 1677. |
| | [e] 20,000, | **80**, 1677. |
| 1881, | [c] 15,000, | **81**, 1851. |
| | [d] 15,000, | **81**, 1851. |
| | [e] 10,000, | **81**, 1853. |
| | [f] 10,000, | **81**, 1853. |
| 1882, | [d] 30,000, | **82**, 1845. |
| | [e] 15,000, | **82**, 1846. |
| | [f] 5,000, | **82**, 1847. |
| 1884, | [g] 50,000, | **84**, 1648. |
| 1886, | [g] 75,000, | **86**, 1517. |
| 1888, | 200,000, | **88**, 1616. |
| 1890, | 250,000, | **90**, 2139. |
| 1892, | 250,000, | **92**, 1939. |
| 1894, | 200,000, | **95**, 2261. |
| 1896, | 20,000, | **96**, 1916. |
| 1897, | 350,000, | **97**, 2228. |
| 1898, | 250,000, | **99**, 2247. |
| 1899, | 100,000, | **1900**, 2247. |
| Total, | [h] 1,890,000 | |

**Commerce.**

Commercial and agricultural resources of country bordering on the Cumberland River, **81**, 1854.

Resources of Upper Cumberland, **84**, 1670.

Present and prospective benefits to commerce, **90**, 2138.

In 1897 it amounted to 54,994 tons below Burnside, valued at $4,000,000, and 27,681 tons above Burnside, value not known, **97**, 2228. In 1898 it was valued at over $4,000,000 below Burnside, **98**, 1882. Value, 1899, $4,490,412, **1900**, 2901.

**Contracts.**

**1888.** Holmes & Wilk, lock and dam construction, $57,080, **89**, 1844. P. L. Hedrick, lock-keeper's house, $2,937.80, **89**, 1844.

**1891.** F. Hartney, timber and stone dike construction, $16,979, **91**, 2275. H. F. Holmes, completion of masonry at lock No. 1, $35,490, **91**, 2276. Rich & Holmes, construction of cofferdam, excavation of lock pit, and completion of masonry of lock No. 2, $163,550, **91**, 2277.

Contract of 1891 with Rich & Holmes terminated by supplementary agreement, Aug., 1892, **93**, 2397.

Open-market purchases of stone, **94**, 1811.

**1894.** Petitdidier & Allen, stone for lock No. 2, $57,864.50. J. H. Connor, stone for lock No. 5, $57,724. **95**, 2262, 2263.

[a] Survey—report Feb. 12, 1835, estimate $45,192.10. (H. Doc. No. 482, 55th Cong., 2d session.)

[b] 1876–79, $151,000.

[c] Nashville to Kentucky line.

[d] Kentucky line to Smith's Shoals.

[e] Smith's Shoals.

[f] Above mouth of Jellico.

[g] Nashville to Smith's Shoals.

[h] See *Appropriations*, p. 294.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part B.—Cumberland River, above Nashville (497 miles)—Cont'd.

**1897.** McArthur Bros., construction of lock and abutment of dam No. 6, $164,871.75; No. 7, $181,689.50. **97,** 2231, 2232.

**1899.** J. E. Sloan & Co., construction of lock approaches, abutments, lock No. 1, about $78,000, **1900,** 2905.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80,** 185; **81,** 250, 258; **82,** 244, 252; **83,** 252; **84,** 253; **85,** 275; **86,** 266; **87,** 234; **88,** 211; **89,** 246; **90,** 222; **91,** 283; **92,** 270; **93,** 305; **94,** 279; **95,** 308; **96,** 267; **97,** 344; **98,** 336; **99,** 399; **1900,** 456.

BOARDS OF ENGINEERS:

Convened at Chattanooga, Mar. 30, 1887, by S. O., No. 43, to examine and report upon Lt. Col. Barlow's project for a lock and dam at Lower Nashville Island. Report, **88,** 1622. (Lt. Cols. Poe and Merrill and Lt. Waterman.) Report by Maj. King, **88,** 1625.

Convened at Nashville, Tenn., Nov. 16, 1889, by S. O., No. 68, to examine and report upon proposed dam at lock No. 1, Cumberland River. Report, **90,** 2144. (Col. Poe and Lt. Cols. Merrill and Barlow.)

Convened at Nashville, Tenn., Aug. 26, 1896, under S. O., No. 21, dated Aug. 3, 1896, to consider and report on modification of project for construction of lock No. 5. Report, **96,** 1916. (Maj. F. A. Mahan, Maj. W. L. Marshall, Capt. J. Biddle.)

ENGINEERS IN CHARGE:

Maj. W. R. King, 1876–86. Reports, **80,** 1675; **81,** 1850, 1854; **82,** 1844, 1862; **83,** 1489; **84,** 1647, 1661, 1662, 1663; **85,** 1762.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86,** 1516; **87,** 1760; **88,** 1614, 1618; **89,** 1840; **90,** 2136; **91,** 2270.

Lt. Col. H. M. Robert, 1892. Report, **92,** 1931.

Capt. J. Biddle, 1893–97. Reports, **93,** 2393; **94,** 1807; **95,** 2254; **96,** 1909; **97,** 2223.

Maj. D. C. Kingman, 1898–99. Report, **98,** 1878.

Lt. Col. M. B. Adams, 1899——. Reports, **99,** 2242; **1900,** 2896.

ASSISTANTS:

Capt. L. C. Overman. Report, **80,** 1678.

Lt. W. L. Marshall. Report, **81,** 1854.

W. C. Crozer. Report, **82,** 1865.

C. A. Turrill. Report, **84,** 1667.

J. S. Walker. Report, **98,** 1889.

**Legal proceedings.**

Purchase and condemnation of land for lock and dam sites, **93,** 2398; **94,** 1812, 1813; **95,** 2257, 2258; **96,** 1913; **97,** 2226, **98,** 1881, 1882; **99,** 2244; **1900,** 2900.

**Operations.**

**1879–80.** Nashville to Kentucky line: 985 c. y. rock, 6,982 c. y. of gravel, and 100 snags removed; 4,323 c. y. rock quarried and 5,604 c. y. dam built; also 596 snags, logs, and trees removed.

Kentucky line to Smiths Shoals: 1,196 snags, logs, and trees, and 50 c. y. of bowlders removed.

Smiths Shoals: 15,652 c. y. loose and solid rock and gravel excavated from the channel, 4,403 c. y. rock quarried, and 11,993 c. y. dam built.

Smiths Shoals to Falls of Cumberland: 218 c. y. rock removed, **80,** 1676, 1677, 1678.

**1880–81.** Nashville to Kentucky line: 10,269 c. y. rock and gravel excavated, 1,847 c. y. rock quarried, and 4,854 c. y. of rock placed in dams and bank riprap.

Kentucky line to Smiths Shoals: 5,139 c. y. rock and gravel excavated, 1,094 c. y. rock quarried, and 3,970 c. y. placed in dams and riprap.

Smiths Shoals: 4,710 c. y. loose and solid rock excavated from channel, 2,038 c. y. masonry and concrete laid, 4,676 c. y. stone quarried, and 12,217 c. y. placed in dams, **81,** 1850, 1851, 1852.

**1881–82.** Nashville to Kentucky line: 10,808 c. y. rock quarried and 12,215 c. y. placed in dams; 8,585 c. y. gravel, 830 c. y. rock, and 376 snags removed.

Kentucky line to Smiths Shoals: 3,789 c. y. rock quarried and 7,048 c. y. of same placed in dams; 13,518 c. y. rock and gravel and 516 snags removed.

Smiths Shoals: 3,264 c. y. rock quarried, 6,700 c. y. placed in dams, and 210 c. y. excauated from channel.

Above mouth of Jellico: 2,414 c. y. rock excavated and 769 snags and trees removed, **82,** 1844, 1845, 1846.

**1882–83.** Nashville to foot of Smiths Shoals: 4,700 c. y. rock quarried, and 16,184 c. y. placed in dams; 5,090 c. y. rock, 410 snags, and 2 wrecks removed.

Smiths Shoals: 655 c. y. rock excavated from channel, 3,424 c. y. rock quarried, and 4,129 placed in dams, **83,** 1489, 1490.

**1883–84.** Nashville to foot of Smiths Shoals: 360 c. y. dredged, 550 snags and trees removed, and 1,475 c. y. rock placed in dams, **84,** 1647.

**1884–85.** Nashville to head of Smiths Shoals: 370 l. f. of dam built, con-

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part B.—Cumberland River, above Nashville (497 miles)—Cont'd.

taining 1,007 c. y. of rock; 480 c. y. rock, 341 snags, and 69 trees removed; 8,812 c. y. rock quarried, and 1,955 l. f. riprap dam built; 6,010 c. y. rock and gravel removed at Upper Nashville Island; 809 c. y. rock and gravel excavated and 1,543 c. y. riprap dam built at Waitsboro Shoals, **85,** 1762, 1763.

**1885–86.** Nashville to head of Smiths Shoals: 1.249 c. y. solid rock, 200 c. y. sand and gravel, and 463 c. y. riprap dam removed; 2,710 c. y. stone quarried and 1,904 c. y. riprap dam built, **86,** 1516.

**1886–87.** Nashville to head of Smiths Shoals: At Smiths, Forbush, and Priestlys shoals, 133 c. y. solid rock and 1,545 c. y. loose rock removed; 1,385 c. y. of embankment built and 1,072 c. y. of stone placed in dams, **87,** 1761.

**1887–88.** 150 c. y. rock and gravel removed; 215 c. y. riprap stone quarried; 721 c. y. riprap dam built; 602 snags removed from channel, and 926 trees from the banks, **88,** 1615.

**1888–89.** 500 c. y. riprap dams built; 81 c. y. brush and stone bank protection placed; 193 snags removed from channel, and 753 trees from the banks; 100 l. f. of cofferdam built, and 865 c. y. rock excavated from lock pit, **89,** 1841, 1842.

**1889–90.** Construction of lock No. 1 continued; cofferdam completed; 5,204 c. y. rock excavated from lock pit; 1,840 c. y. stone quarried, **90,** 2137.

**1890–91.** 1,700 c. y. of earth and 10,855 c. y. of rock excavated from lock pit at lock and dam No. 1; 842 c. y. of masonry quarried, **91,** 2271. 3,000 c. y. of earth excavated for lock site at lock and dam No. 2, and construction of cofferdam begun, **91,** 2272. 1,011 snags and 1,708 bowlders removed from the channel, and 7,795 trees cleared from the banks, **91,** 2273.

**1891–92.** 300 snags removed from the channel, and 1,643 overhanging trees cleared from the banks, **92,** 1935. Construction of lock and dam Nos. 1 and 2 continued, **92,** 1936.

**1892–93.** Old dredge purchased and machinery from it transferred to new hull; construction of lock No. 1 in progress, and work begun on No. 3 and No. 4; nearly 12,000 snags and other obstructions removed; some rock excavated and placed in dams; dam that was at left bank of Holleman Island transferred to right bank, **93,** 2399.

**1893–94.** Construction of locks Nos. 1, 3, and 4 continued, and work on Nos. 2 and 5 begun, **94,** 1812. Small steamboat built, and additions made to plant, **94,** 1814. At Wild Goose Shoals, old main dam was cut down to low water for about 450 feet; check dam was built, and channel cleared. At Kettle Creek Shoals, dam 116 feet long built with rock from channel, some rock and nearly 1,200 obstructions removed; dams repaired, **94,** 1815.

**1894–95.** Work continued on locks Nos. 2, 3, 4, and 5, **95,** 2257. Small steamboat built. Dams repaired and extended at Fishing Creek and at Forbush Shoals, **95,** 2259. Nearly 19,000 leaning trees and 4,000 snags, etc., removed, **95,** 2259, 2260.

**1895–96.** Locks Nos. 2, 3,4, and 5, in course of construction, **96,** 1912, 1913. Nearly 600 snags and other obstructions removed, **96,** 1914.

**1896–97.** Work on locks Nos. 2 and 5 continued, **97,** 2225. About 1,700 obstructions of various kinds removed, **97,** 2226.

**1897–98.** Work continued on locks Nos. 3 and 5 and begun on Nos. 6 and 7, **98,** 1880. New hull built for *Weitzel*. Snagboat repaired and refitted, **98,** 1881, 1882.

**1898–99.** Work at lock No. 5 carried on by hired labor, and at Nos. 6 and 7 by contract; work of clearing obstructions from the channel above Nashville begun; about 2,000 obstructions removed, **99,** 2243.

**1899–1900.** Work of last year continued; work begun at lock No. 1; over 2,000 obstructions removed, **1900,** 2897.

**Physical characteristics.**

Description of Smiths Shoals, **82,** 1865.

Table of distances, with fall of water on shoals, and average depth in pools on the lower Cumberland River from lock No. 1; upper river improvement to the Ohio River, **90,** 2140.

Description of, after examination made 1893–94, at Wild Goose, Kettle Creek, and Smiths Shoals, **94,** 1815.

Bankslides, **96,** 1914.

**Plans.** (See *Projects.*)

By Maj. King, 1881, Smiths Shoals, locks and dams, using the river itself as a canal, by the construction of a dam at head of Mill Shoal in connection with 4 locks of 16 f. lift and 55 by 140 f. in chambers. Estimate, $560,000, or for a more complete improvement an additional dam, with 3 locks near Shadowen Shoal; estimate, $965,000, **82,** 1863, 1864.

Recommended that present system of dams be tried one year longer before attempting a more radical improvement, **82,** 1865.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part B.—Cumberland River, above Nashville (497 miles)—Cont'd.

**Private work.**

Value and description of the private dams above the mouth of the Jellico, **83**, 1491, 1492; **87**, 1762, 1763.

**Projects.** (See *Plans.*)

By Maj. Weitzel, 1872, Falls of the Cumberland to Nashville, 372 miles, excavation of ledges, sand and gravel bars, concentration of water by wing dams, removal of snags and bowlders, and the restriction of tributaries to determined channels; estimate, $258,864, **71**, 470,478; **72**, 471; **77**, 594.

By Maj. McFarland, 1875, Smiths Shoals wing dams to give descending coal boats a depth of 4 f. during mean high water, **75**, 795, 796.

In 1881, Maj. King, Jellico to Cumberland Ford, 110 miles, removal of snags, trees, and similar obstructions; estimate, $55,000, **81**, 1853; **87**, 1736.

Above mouth of Jellico: By Maj. King, 1881, Jellico to Cumberland Ford, 110 miles, removal of snags, trees, and similar obstructions; estimate, $55,000, **81**, 1853; **87**, 1763.

By Maj. King, 1884, Nashville to the head of Smiths Shoals; slack-water navigation, with 23 locks between Nashville and Point Burnside, and 7 locks at Smiths Shoals, giving a depth of 5 f. on the lower miter sills; estimate, $4,077,922, **84**, 1663, 1665; **87**, 1761.

Dimensions of locks, as fixed by Board of Engineers, 280 f. long and 52 f. wide, **87**, 1760.

In 1891 locks of larger dimensions than those contemplated in the original project and estimates having been recommended by the Board of Engineers, the estimate was revised, making the cost of the 23 locks and dams between Nashville and Point Burnside $5,750,000, and to continue the improvement to the head of Smiths Shoals, with 7 additional locks and dams, was estimated to cost $1,750,000, making the total estimate, revised project, $7,500,000, **91**, 2270; **92**, 1938.

List of lands acquired for lock and dam sites, distances from Nashville, acreage and cost — Nos. 1, 2, 3, 4, 5, 6 (new site of No. 2 included), **94**, 1814; Nos. 1 to 8, and Nos. 21 and 22, **95**, 2259; **96**, 1914.

Construction by hired labor and open-market purchases authorized, **93**, 2399.

Act of 1892 appropriated $20,000 to be applied to locks and dams Nos. 21 and 22, and provided for completing the whole or any parts of Nos. 5, 6, and 7, at a cost not to exceed $600,000, **96**, 1914; **99**, 2243.

By Capt. Biddle, 1896, for increasing, because of the small appropriations, the estimated cost of the river improvement to $9,000,000. Estimated cost of annual maintenance $5,000, to be increased from $4,000 to $6,000 as each lock would be completed. Estimated cost of annual maintenance of the whole system of 30 locks when completed, $150,000, **96**, 1916.

Smiths Shoals: Act of 1892 allotted $5,000, **93**, 2399; **94**, 1816. Act of 1894 allotted $5,000, **95**, 2261. Sites of locks and dams, Nos. 1 to 6 approved, **96**, 1915. Project revised by Capt. Biddle, 1896, to provide for increasing height of 6 locks to save the construction of a seventh, **96**, 1915.

Lt. Col. Adams, 1899, estimated that it would cost $898,740.15, and take two years to make locks 1-7 operative and to give 6 f. navigation, **99**, 2245.

**Surveys.**

For canal around Smiths Shoals ordered by act of March 3, 1881, made under direction of Maj. King, **82**, 1862.

Examination of Cumberland River and principal tributaries above Pineville made, 1882, under direction of Maj. King, **84**, 1661.

Examination and survey, with view to location of locks and dams on river, from Nashville to Cincinnati Southern R. R., made, 1882, 1884, under direction of Maj. King, **84**, 1662, 1663.

Surveys and examinations made almost every year from 1893-1900 for lock and dam sites. (See references, *Engineers in charge.*)

MAPS. **98**, 1888.

### Part C.—Cumberland River, below Nashville (191 miles).

**Appropriations.**[a]

| | | | |
|---|---|---|---|
| 1880, | $20,000, | **80**, | 1675. |
| 1881, | 15,000, | **81**, | 1850. |
| 1882, | 15,000, | **82**, | 1844. |
| 1884, | 7,500, | **84**, | 1647. |
| 1886, | 12,500, | **86**, | 1517. |
| 1888, | 10,000, | **88**, | 1614. |
| 1890, | 40,000, | **90**, | 2136. |

**Appropriations**—Continued.

| | | | |
|---|---|---|---|
| 1892, | 40,000, | **92**, | 1931. |
| 1894, | 30,000, | **95**, | 2254. |
| 1896, | 80,000, | **96**, | 1909. |
| 1899, | 100,000, | **99**, | 2241. |
| Total, | [b]370,000 | | |

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[a] 1832-79, $340,000.

[b] See *Appropriations*, p. 294.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part C.—Cumberland River, below Nashville (191 miles)—Cont'd.

**Commerce.**

Extension of season of navigation, **84,** 1645.

Valued at $1,500,000, **97,** 2223; at nearly $8,000,000, **98,** 1877; 1899, at nearly $4,771,049, **1900,** 2893.

If large boats could navigate the river all the year there would probably be a reduction of 40 to 50 per cent in freight rates, **1900,** 2894.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80,** 185; **81,** 249; **82,** 244; **83,** 251; **84,** 252; **85,** 274; **86,** 266; **87,** 233; **88,** 210, 1627; **89,** 245, 248; **90,** 221, 223; **91,** 282; **92,** 270; **93,** 304; **94,** 278; **95,** 306; **96,** 265; **97,** 342, 347; **98,** 334; **99,** 399; **1900,** 454.

BOARD OF ENGINEERS. Convened at Chattanooga, June 16, 1888, by S. O. No. 22, to report upon a plan for the improvement of the mouth of the Cumberland. Report, **88,** 1628. (Lt. Cols. Merrill and Barlow, Maj. Mackenzie, and Lt. Waterman).

ENGINEERS IN CHARGE:

Maj. W. R. King, 1876–86. Reports, **80,** 1674; **81,** 1849; **82,** 1843; **83,** 1487; **84,** 1644; **85,** 1760.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86,** 1515; **87,** 1758; **88,** 1611, 1626, 1631; **89,** 1837; **90,** 2133, 2151, 2152; **91,** 2268.

Lt. Col. H. M. Robert, 1892. Report, **92,** 1928.

Capt. J. Biddle, 1893–97. Reports, **93,** 2390; **94,** 1805; **95,** 2251; **96,** 1906; **97,** 2220, 2242.

Maj. D. C. Kingman, 1898–99. Report, **98,** 1875.

Lt. Col. M. B. Adams, 1899–. Reports, **99,** 2242; **1900,** 2891.

ASSISTANTS:

C. A. Locke. Report, **90,** 2158.
B. B. Smith. Report, **90,** 2159.
J. S. Walker. Report, **98,** 1885.

**Legal proceedings.**

Site for land at dam, about 2½ miles below mouth of Harpeth River, condemned. Title vested in United States by court, **94,** 1806–1807; **95,** 2253; **98,** 1877.

**Operations.**

**1879–80.** 571 c. y. rock, 5,535 c. y. gravel, and 52 snags removed from the channel; also 19,510 c. y. of rock quarried, and 23,453 c. y. of dam built. The work was done at Palmyra Island and Harpeth, Dover, Ingram, Race Track, and Little River shoals, **80,** 1675.

**1880–81.** 676 snags, roots, and overhanging trees removed, and 11,367 c. y. rock quarried, and 23,206 c. y. dam built, **81,** 1850.

**1881–82.** 583 snags and roots, 305 c. y. gravel, and 67 c. y. rock removed from channel; also 6,390 c. y. rock quarried and built into dams, **82,** 1844.

**1882–83.** 938 snags, 1,628 c. y. rock and gravel, and 2 wrecks removed; 3,397 c. y. rock placed in dams, and 740 l. f. brush dam built, **83,** 1489.

**1883–84.** 200 c. y. material dredged, 1,778 c. y. rock quarried, and 1,240 c. y. rock put in dams, **84,** 1646.

**1884–85.** 1,100 c. y. rock quarried and placed in dams, 128 snags and 2,595 c. y. gravel removed, **85,** 1761.

**1885–86.** 171 c. y. stone quarried, and 230 c. y. riprap dam built; 12 snags, 276 c. y. sand and gravel, and 361 c. y. of loose rock removed, **86,** 1515.

**1886–87.** 26 snags and 15 trees removed from river between Nashville and Robesson Island, **87,** 1758.

**1887–88.** 5,780 c. y. riprap dam built; 4,800 c. y. riprap stone quarried; 517 snags removed from the channel, and 1,065 from the banks, **88,** 1612.

**1889–90.** 116 snags and stumps and 10 c. y. solid rock removed from channel; 330 c. y. stone quarried, and repairs to dams, **90,** 2134.

**1890–91.** 40 c. y. sand and gravel removed at Lower Gatlin Shoal; 748 c. y. of rock removed from longitudinal dam, and 923 c. y. of new spur riprap dam built; 22 snags and 550 overhanging trees cleared from channel and banks, **91,** 2268.

**1891–92.** 1,210 snags, 61 c. y. rock, 1,050 c. y. gravel, and 15 tons of wreckage removed from the channel, and 1,139 trees cleared from the banks; reconstruction of spur dams at Cumberland Island, **92,** 1929.

**1892–93.** 1,047 piles driven, 6,577 c. y. stone, and some brush placed in dike at river mouth; over 1,000 obstructions removed; dam repaired; old dams removed, comprising about 800 c. y. loose rock, etc.; 1,092 piles, 6,041 c. y. stone, and 545 cords brush used in protecting 3,150 l. f. bank at foot of Cumberland Island, **93,** 2391, 2392.

**1893–94.** 2,000 c. y. stone and 255 cords brush placed in dike at mouth, **94,** 1806.

**1894–95.** Preparations made for construction of lock and dam at Harpeth shoals; nearly 12,000 leaning trees cut and over 2,000 other obstructions removed; about 500 c. y. rock and earth removed; willows planted for bank protection; and riprap dam repaired, **95,** 2253.

**1895–96.** Lock site and surrounding land at Harpeth shoals cleared, temporary buildings erected, cofferdam built, some

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part C.—Cumberland River, below Nashville (191 miles)—Cont'd.

rock and 3,892 c. y. sand and other material excavated for foundation.

Old dam at upper end of Cumberland Island partly torn out; boundary of United States land marked; some obstructing material removed; hull for snag boat built. **96**, 1908.

**1896–97.** Some obstructions removed; small channel cut, riprap dam built; preparations made for continuance of work at Harpeth shoals, **97**, 2222, 2223.

**1897–98.** Stone quarried and cut, and a large amount of miscellaneous work performed at lock and dam A, **98**, 1877.

New hull built for *Weitzel*, old machinery repaired, and new added. Boat renamed *Cumberland*. **98**, 1877.

**1898–99.** Work at lock A continued, **99**, 2240.

**1899–1900.** Work of preceding year continued (stone quarried, lock pit excavated, filling, stone cutting, masonry work, etc.); obstructions removed, **1900**, 2892.

**Physical characteristics.**

Description of, lower Cumberland, **90**, 2154.

Current velocities, lower Cumberland, **90**, 2161.

Harpeth shoals looked on as the most formidable obstruction of the lower Cumberland, **95**, 2253.

Description of, at mouth. Conditions improving, **97**, 2243.

High water of 1896 especially disastrous to banks, **96**, 1908.

**Projects.**

From 1832 to 1871, inclusive, $185,000 was appropriated for this part of the river, **74**, 578.

By Maj. Weitzel, 1872, Cumberland River below Nashville, to give a low-water depth of 3 f., excavation of ledges, sand and gravel bars, removal of snags and bowlders, concentration of water by wing-dam construction, and restriction of tributaries to determined channels; estimate, $248,821, **71**, 480; **72**, 462. Total estimate increased in 1884 to $348,000, **84**, 1646; **87**, 1759.

In 1888 the Board of Engineers provided for the improvement of the Cumberland at its mouth, closing the left channel around the tow head by a pile and brush dam 20 f. wide and rising to low-water level, capped by crib work built up to the 8 f. stage of the river; estimate, $129,600. (Lt. Cols. Merrill and Barlow, Maj. Mackenzie, and Lt. Waterman.) This, together with $20,000 proposed by Lt. Col. Barlow, 1888, for snagging at Gatlin Shoals, increases the total estimate for the improvement of the lower Cumberland to $497,600, **88**, 1613, 1614, 1630, 1631; **90**, 2158.

By Lt. Col. Barlow, 1889, Cumberland River, Nashville to Big Eddy, 144 miles, 7 locks and dams; estimate, $1,783,350, **90**, 2157.

The project in force at 1893–94 consisted of (1) extension of lock and dam system of upper to lower river, 7 locks and dams, from near the mouth of Harpeth River (A) to Big Eddy Shoals (G), to be constructed, to be 280 f. long by 52 f. wide, the lifts of the locks varying from 8¼ to 11¼ f., aggregating about 70 f.; (2) improvement of Kentucky Chute at mouth of river; (3) channel work below lock G; (4) snagging and removal of surface obstructions below Nashville. Total estimate, $1,964,500, **94**, 1806. The cost of maintenance at 1894 was estimated at about $5,000 per annum, with a probable increase of from $4,000 to $6,000 per lock. When the whole system of locks would be completed $50,000 would be required for annual maintenance, **96**, 1909.

After survey of 1897 Capt. Biddle believed that $20,000 should be appropriated for maintenance of works at the mouth, to be used when necessary, **97**, 2245.

Immediate construction of lock B urged, 1900, **99**, 2241.

Immediate completion of lower river scheme of improvement and of the lower part of the upper river scheme urged, **1900**, 2894.

**Surveys.**

Survey of the lower Cumberland, with a view to slack-water navigation, ordered by act of August 11, 1888, made, 1889, under direction of Lt. Col. Barlow, **90**, 2152.

Survey for site of lock and dam A, near mouth of Harpeth River, as provided for by act of July 13, 1892, made in 1892–93 by Capt, Biddle, **93**, 2392.

Survey for lock and dam B, made 1896–97, **97**, 2222.

Resurvey of the mouth was ordered by act of June 3, 1896, and made in that year by Capt. Biddle (see *Projects*), **97**, 2242.

MAPS. **88**, 1631; **90**, 2156.

## CUMBERLAND RIVER, KY. AND TENN.—Continued.

### Part D.—Cumberland River, Ky. (South Fork).

**Appropriations.**

| | | | |
|---|---|---|---|
| 1882, | $3,000, | **82**, | 1862. |
| 1884, | 4,000, | **84**, | 1661. |
| 1886, | 5,000, | **86**, | 1525. |

Total, 12,000.

**Engineers.**

Chief of Engineers. Reports, **80**, 190; **81**, 258; **82**, 252; **83**, 259; **84**, 259; **85**, 279; **86**, 270; **87**, 235; **88**, 211; **89**, 274; **90**, 222; **91**, 285; **92**, 273.

Engineers in Charge:

Maj. W. R. King, 1881–86. Reports, **81**, 1896; **82**, 1862; **83**, 1508; **84**, 1660; **85**, 1770.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86**, 1525; **87**, 1765; **88**, 1633; **89**, 1846; **90**, 2148; **91**, 2286.

Lt. Col. H. M. Robert, 1892. Report, **92**, 1943.

Assistant. W. C. Crozer. Report, **81**, 1897.

**Operations.**

**1882–83.** Brush dam built, 50 trees cut, 60 c. y. stone quarried for dams, **83**, 1508.

**1884–85.** 556 c. y. solid rock blasted, 368 c. y. loose rock excavated, 108 c. y. stone quarried for riprap, 1,665 c. y. riprap dam built, 161 trees cut and removed, **85**, 1770.

**1886–87.** 230 c. y. solid and 583 c. y. loose rock removed, 2,066 c. y. stone placed in wing-dams at Sloan's and Robert's shoals, **87**, 1765.

**1887–88.** 607 c. y. riprap quarried, and 2,000 c. y. of spur dam built, **88**, 1633.

**Projects.**

By Maj. King, 1881, 44 miles of river below Devils Jump, removal of gravel bars and bowlders, excavating channel through rocky reefs, and construction of wing-dams, to secure safe navigation at stages of the river when at least 3 f. above low water; estimate, $62,803, **81**, 1897, 1898; **86**, 270; **87**, 235; **90**, 2149.

**Survey.**

Ordered by act of June 18, 1878, made, 1879, under direction of Maj. King, **81**, 1896.

## CUMBERLAND SOUND, FLA. AND GA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $30,000, | **80**, | 966. |
| 1881, | 100,000, | **81**, | 1123. |
| 1882, | 50,000, | **82**, | 1187. |
| 1884, | 75,000, | **84**, | 1123. |
| 1886, | 112,500, | **86**, | 1121. |
| 1888, | 112,500, | **88**, | 1053. |
| 1890, | 112,500, | **90**, | 1426. |
| 1892, | 170,000, | **92**, | 1290. |
| 1894, | 170,000, | **95**, | 1512. |
| 1896, | 5,000, | **96**, | 1289. |
| 1897, | 350,000, | **97**, | 1529. |
| 1897, | 50,000, | **98**, | 1326. |
| 1898, | 450,000, | **98**, | 1326. |
| 1899, | 400,000, | **99**, | 1595. |

Total, 2,187,500

**Commerce.**

Cumberland Sound as a harbor of refuge, **76**, 482; **79**, 792.

Commercial superiority of location doubtful, **76**, 483.

Benefit to be conferred by improvement, **81**, 1122; **87**, 1194.

Amount of, dependent upon water transportation through Cumberland Sound, **90**, 1424; **91**, 1561.

Description of, **93**, 1603; **96**, 1291; **1900**, 1957, 1958.

In 1892 the freight was valued at $8,982,393, **93**, 1596; in 1896, at about $9,000,000, **97**, 1529; 1899, $3,861,992, **1900**, 305.

All the commerce of St. Marys, Ga., and 90 per cent of the commerce of Fernandina, Fla., dependent upon the sound for transportation, **96**, 1288.

**Contracts.**

**1880.** Lara, Ross & Co., jetty construction, **81**, 1121.

**1881.** A. M. Newton, jetty construction, **82**, 1187.

**1882.** Lara & Ross, jetty construction, **83**, 935.

**1884.** Lara & Ross, jetty construction, 59 cents per s. y. for mattress and $3.09 per c. y. for stone, **85**, 1232.

**1888.** Anson M. Bangs, jetty construction, stone $3.27 and shells $1.27 per c. y., **89**, 1276.

**1891.** J. F. Gaynor, brush mattress 97 cents and log and brush mattress 99 cents per s. y., and stone $3.49 per c. y., **91**, 1563.

**1892.** E. H. Gaynor, jetty construction—mattresses, $1.05 per s. y.; riprap stone, $3.59 per c. y. ($184,520), **93**, 1597.

**1896.** Atlantic Contracting Co., jetty construction—mattresses, $1.10 per s. y.; 1st class stone, $5.25 per ton; 3d and 4th class stone, $3.90 and $3.50 per c. y. ($2,141,250), **97**, 1530. Annulled 1899, **1900**, 1957.

**1900.** Christie, Lowe & Heyworth, jetty construction, stone, $1.90 to $2.15 per ton; mattresses, 70 cents per s. y. ($1,100,750), **1900**, 1959.

## CUMBERLAND SOUND, FLA. AND GA.—Continued.

**Defense.**

Fitness for a military or naval depot, **76**, 481, 482.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 71; **79**, 99, 100; **80**, 130, 136; **81**, 176; **82**, 172; **83**, 182; **84**, 189; **85**, 189; **86**, 189; **87**, 152; **88**, 142; **89**, 163; **90**, 146; **91**, 184; **92**, 180; **93**, 197; **94**, 181; **95**, 206; **96**, 184; **97**, 235; **98**, 232; **99**, 267; **1900**, 304.

BOARDS OF ENGINEERS:

Convened at Washington, Nov. 10, 1888, by S. O. No. 50, to report upon a project for the improvement of Cumberland Sound. Report, **89**, 1281. (Lt. Cols. Gillespie and King and Maj. Post.)

Convened at Savannah, Ga., Sept. 25, 1895, by S. O. No. 41, to consider and report upon the subject of the improvement of the sound. Report, **96**, 1289. (Col. P. C. Hains, Maj. T. H. Handbury, Capt. W. M. Black, Capt. F. V. Abbot, Capt. O. M. Carter, Addl. Lt. H. Burgess.)

Constituted June 22, 1900, for further consideration of the existing project, **1900**, 1956.

ENGINEERS IN CHARGE:

Lt. Col. Q. A. Gillmore, 1876–87; **76**, 71; **79**, 95. Reports, **76**, 446; **79**, 792; **80**, 965, 1036; **81**, 1120; **82**, 1183; **83**, 931; **84**, 1121; **85**, 1229; **86**, 1118; **87**, 1191.

Lt. O. M. Carter, 1888–97. Reports, **88**, 1950; **89**, 1273, 1280; **90**, 1422; **91**, 1559, 1565; (Capt.), **92**, 1286; **93**, 1593, 1599; **94**, 1200; **95**, 1508; **96**, 1285; **97**, 1526, 1533.

Lt. Col. W. H. H. Benyaurd, 1897–98. Report, **98**, 1323.

Capt. C. H. McKinstry, 1899. Report, **99**, 1593.

Capt. C. E. Gillette, 1899–. Report, **1900**, 1956.

ASSISTANTS.

G. Daubeney. Report, **80**, 1037.

Lt. W. L. Fisk. Report, **81**, 1124.

Capt. J. C. Post. Reports, **82**, 1188; **83**, 938.

Lt. W. T. Rossell. Reports, **83**, 935; **84**, 1123.

W. R. Curtis. Reports, **85**, 1232; **88**, 1054.

Lt. O. M. Carter. Reports, **86**, 1122; **87**, 1196.

M. P. Paret. Reports, **89**, 1276; **90**, 1426.

**Estimates.** (See *Plans.*)

By Lt. Col. Gillmore, 1876, as follows: Full-height jetties across bar, mixed system $4,908,703, riprap system $6,821,100; full-height jetties to crest of bar, mixed system $2,589,600, riprap system $4,463,940; stump jetties, mixed system, $1,969,262, riprap system $3,086,620; drowned jetties full length, mixed system $1,817,311, riprap system $2,423,460; drowned north jetty and full-height south jetty, mixed system $3,759,161, riprap system $4,513,860, **76**, 477–481.

By Lt. Col. Gillmore, 1879, low jetties, $2,071,023, **79**, 793.

**Operations.**

**1880–81.** 276 l. f. of apron foundation laid and covered with riprap stone, **81**, 1121.

**1881–82.** Apron foundation of north jetty extended 2,010 f., bottom course extended 7,196 f., 10,824 c. y. stone deposited on work, apron foundation of south jetty extended 1,316 f., 2,443 c. y. riprap stone deposited, **82**, 1184, 1185.

**1882–83.** Second course mattress north jetty extended 73 f., foundation mats for spurs placed and covered with riprap stone, 4,475 c. y. stone used, foundation course of south jetty extended 2,851 f., 7,350 c. y. riprap placed, **83**, 933.

**1884–85.** Bottom course of Smith Jetty advanced 3,507 f., 13,487 c. y. riprap used, **85**, 1230.

**1886–87.** 33,303 s. y. of mattress foundation and 10,336 c. y. of stone placed in jetties, **87**, 1193.

**1887–88.** 37,725 s. y. wattling and 11,821 c. y. stone placed in jetty, **88**, 1052.

**1888–89.** 10,513 c. y. stone and 1,253 c. y. shell placed in the jetty, **89**, 1277.

**1889–90.** 18,060 c. y. stone and 818 c. y. shell placed in the jetty, **90**, 1426.

**1890–91.** 2,770 s. y. of brush mattress and 382 c. y. of stone used in extending the foundation course of the north jetty 267 f., **91**, 1561.

**1891–92.** 58,759 s. y. brush mattress and 11,429 c. y. stone used in extension of foundation course of north jetty 6,177 f., **92**, 1288.

**1892–93.** 107,734 s. y. mattresses and 13,683 c. y. riprap stone placed on north jetty, **93**, 1595.

**1894–95.** 213,334 s. y. mattresses were loaded down with 18,748 c. y. riprap stone on the north jetty. A portion of the south jetty 300 f. long was removed where the sailing line crossed it, **95**, 1511.

**1896–97.** 92,345 s. y. mattresses and 4,794 c. y. third-class stone and 842 c. y. riprap stone placed on north jetty; 253,942 s. y. mattresses, 4,036 c. y. third-class stone, 8,018 c. y. fourth-class stone, and 607 c. y. riprap stone for repairs placed on south jetty, **97**, 1528.

**1897–98.** 111,868 s. y. mattresses, 375 c. y. third-class stone, and 7,616 c. y. fourth-class stone were placed on north

## CUMBERLAND SOUND, FLA. AND GA.—Continued.

jetty; 1,361 c. y. fourth-class stone were placed on mattresses previously sunk, and some repairs made on south jetty, **98,** 1324. 87,311 c. y. dredged, 129 c. y. rock removed, and a few logs and other obstructions removed, **98,** 1325.

**1898–99.** 19,316 c. y. dredged, 1,237 c. y. rock and 366 logs removed from channel, **99,** 1594.

**Physical characteristics.**

Description of, **76,** 446, 447, 482; **79,** 792; **93,** 1600, 1604; **96,** 1287, 1290; **97,** 1529, 1534; **99,** 1595.

Locations of channels since 1843, **76,** 447, 448, 449.

Tidal observations, **76,** 450, 453, 457, 482; **91,** 1576.

Amount of rainfall, **76,** 457, 458.

Depths at entrance to Cumberland Sound, **76,** 462, 463, 465, 466, 469.

Direction and velocity of currents, **91,** 1581, 1582.

Ebb and flood volumes, **91,** 1591.

Borings, **91,** 1596.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Col. Gillmore, 1876. Discussion of jetty plans: Full-height jetties extending across the bar, **76,** 459–462; full-height jetties reaching the crest of the bar, **76,** 462–467; stump jetties, **76,** 467–471; full-length drowned jetties, **76,** 471–475; full-length drowned north jetty and full-height south jetty, **76,** 475. Duration of the improved channel, **76,** 475. Lt. Col. Gillmore preferred low jetties to high, **76,** 477; recommended neither of these plans for execution, but simply a channel 13 f. deep at m. l. w. across the bar, **76,** 483.

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Gillmore, 1879. Two low jetties of riprap stone resting upon a foundation mattress of logs and brush, starting from the shores on opposite sides of the entrance and extending seaward across the bar, with outer ends parallel to each other and from 3,000 to 3,500 f. apart, designed to give a low-water channel 20 to 21 f. deep; estimate, $2,071,023, **79,** 793; **80,** 965; **86,** 189; **87,** 1191; **91,** 1566, 1573; **92,** 1286.

In 1891 the Board of Engineers fixed the width between the outer ends of the jetties at 3,900 f., and made the elevation of the south jetty to high water throughout its entire length provisional upon failure to secure sufficient depth with lower jetties, **91,** 1601.

By Capt. Carter, 1895, approved by Board of Engineers, 1895. For two jetties of riprap stone, with mattress hearting wherever admissible, resting upon a foundation mattress of brush or of logs and brush, starting from the shores on opposite sides of the entrance and extending seaward upon lines so directed that the ends resting in 30 f. depth at m. l. w. would be parallel to each other and about 3,900 f. apart, to establish a m. l. w. channel across the bar of not less than 19 f. depth. After including the above the estimate would be increased to $2,350,000, **97,** 1527.

After receiving a report from Capt. Carter, 1897, recommending the commencement under the project of dredging, sluicing, and the raising of the north and south jetties under the existing contracts, Congress appropriated the amount recommended for this purpose, $50,000, **97,** 1533; **98,** 1324.

**Surveys.**

Of entrance to sound, ordered, **79,** 100.

Ordered by act of June 14, 1880, made 1880, under direction of Lt. Col. Gillmore, **80,** 1036; **86,** 1120; **87,** 1188.

Examinations made, 1894–95, by Capt. Carter, **94,** 1202; **95,** 1511.

Surveys were made of the entrance, 1897, by Capt. Carter, **97,** 1528; 1897, by Capt. Gillette, **98,** 1324; and by Lt. Col. Benyaurd, 1898, **98,** 1325.

Survey made, 1899, by Capt. McKinstry, **99,** 1594.

Survey made, 1900, by Capt. Gillette, **1900,** 1957.

MAPS:

Two plates with sketches of proposed jetties; profiles and sketches of current directions, etc., **76,** 483; **83,** 934; **85,** 1232; **88,** 1052; **89,** 1276; **91,** 1561; **92,** Atlas, 60; **93,** 1596; **98,** 1326; **99,** 1596.

## CUMBERLAND SOUND TO ST. SIMONS SOUND, GA. (inside passage).

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76,** 71.

ENGINEER IN CHARGE. Lt. Col. Q. A. Gillmore, 1876; **76,** 71. Report, **76,** 484.

**Physical characteristics.**

General description of water-courses between Cumberland and St. Simons Sounds, **76,** 484.

**Plans.**

By Lt. Col. Gillmore, dredging channel 100 f. wide on bottom and 6 f. deep at m. l. w.; estimate. $10,000, and $1,500 annually for dredging, **76,** 485.

**Survey.**

Under direction of Lt. Col. Gillmore, 1875–76. Report, **76,** 484.

## CUNNINGHAM CREEK, OHIO.[a]

**Appropriations.**[b]

| | |
|---|---|
| 1826, | $2,000.00 |
| 1828, | 1,517.76 |
| 1829, | 2,956.00 |
| 1832, | [c] 1,500.00 |
| 1833, | [c] 500.00 |
| 1836, | 1,257,00 |
| 1836, | 32.36 |
| 1837, | 5,000.00 |
| 1838, | 5,000.00 |
| Total, | 19,781.12 |

## CURRENT RIVER, ARK. AND MO.

**Appropriations.**

| | |
|---|---|
| 1872, | $5,000, **73**, 55. |
| 1881, | 2,000, **81**, 1517. |
| 1894, | 8,000, **95**, 2030. |
| 1896, | 2,000, **96**, 1690. |
| 1899, | 5,000, **99**, 2042. |
| Total, | 22,000 |

**Commerce.**

Amount of commerce benefited by improvement, **72**, 396.

Description of, small, **93**, 2128; **95**, 2030; **1900**, 2616.

**Contracts.**

**1895.** H. J. George & Co., subsistence supplies, $863.41. D. E. Jones Co., ship supplies, $1,601.36. **95**, 2031.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 59; **73**, 55; **80**, 158; **81**, 213, 219; **82**, 217; **83**, 224; **91**, 257; **93**, 279; **94**, 254; **95**, 285; **96**, 247; **97**, 314; **98**, 306; **99**, 367, 369; **1900**, 422, 424.

ENGINEERS IN CHARGE:

Lt. Col. W. F. Raynolds, 1871–72. Report, **72**, 395.

Col. J. H. Simpson, 1872–73. Report, **73**, 461.

Maj. W. H. H. Benyaurd, 1880–82. Reports, **81**, 1467, 1517.

Capt. T. H. Handbury, 1882–83. Reports, **82**, 1586; **83**, 1175.

Capt. H. S. Taber, 1890–93. Reports, **91**, 2065; **93**, 2128.

Lt. Wm. L. Sibert, 1895–98. Reports, **95**, 2029; (Capt.) **96**, 1689; **97**, 1978; **98**, 1671.

Lt. Robert McGregor, 1899–. Reports, **99**, 2042; (Capt.) **1900**, 2608, 2614.

ASSISTANTS:

J. D. McKown, **73**, 460.

A. D. Wolf, **73**, 460.

A. H. Blaisdell. Report, **72**, 395.

J. R. Van Frank. Reports, **91**, 2067; **1900**, 2609, 2615.

**Obstructions.**

The Current Railway bridge the only permanent obstruction, **1900**, 2617.

**Operations.**

**1871–72.** 123 snags and 592 leaning trees removed, and 1,040 l. f. of brush and wing dams built, **73**, 55, 461.

**1881–82.** 180 snags removed, 3,000 overhanging trees cut, **82**, 1586.

**1882–83.** 85 snags removed, **83**, 1175.

**1894–95.** About 1,300 snags and other obstructions removed, **95**, 2030.

**1895–96.** About 2,600 snags, etc., removed, **96**, 1690.

**1896–97.** About 300 snags, etc., removed, **97**, 1978.

**1897–98.** About 1,200 snags, etc., removed, **98**, 1671.

**1898–99.** About 50 obstructions removed from channel, **99**, 2042.

**1899–1900.** About 7,500 obstructions removed from channel, **1900**, 2609.

**Physical characteristics.**

Description of, **72**, 396; **91**, 2065; **93**, 2128; **1900**, 2615.

**Private (State) work.**

In 1855 Missouri appropriated $10,000; expended, 1857, in removing snags and leaning trees, **72**, 397. In 1871 $20,000 was appropriated by the State, **72**, 397; **73**, 460.

**Projects.**

By Lt. Col. Raynolds, removing snags, leaning trees, and construction of dams of brush and stone; estimate, $25,722.62, **72**, 398.

By Maj. Benyaurd, 1880, concentration of water over shoal places with brush and stone wing dams, and for removal of snags, logs, and trees from channel; estimate, $17,365, **81**, 1517.

By Capt. Taber, 1890, to remove logs, etc., from the channel, and also to contract the water width at worst places by wing dams; estimate, $10,000, **91**, 2066; **93**, 2029.

In 1897 Capt. Sibert estimated it would cost $2,000 annually for maintenance, **97**, 1978.

**Surveys.**

Ordered by act approved Mar. 3, 1871, **71**, 59. Assigned to Lt. Col. Raynolds

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[a] Survey—Report July 17, 1826, estimate $2,000. (Treasury Doc. 373, 1882. H. R. Doc. 482, 55th Cong. 2d sess.)

[b] Removing obstructions at mouth of the creek.

[c] Pierhead.

**CURRENT RIVER, ARK. AND MO.**—Continued.

made by A. H. Blaisdell. Report, **72**, 395.

Ordered by act of June 14, 1880, made, 1880, under direction of Maj. Benyaurd, **81**, 1467.

Examination made, 1890, under direction of Capt. Taber, **91**, 2065.

Examination ordered by act of July 13, 1892, made, 1893, by Capt. Taber (report favorable to snagging), **93**, 2128.

Examination, junction with Crooked Creek to the southern line of Carter County, Mo., ordered by act of Mar. 3, 1899, made, 1899, under direction of Lt. McGregor (report unfavorable), **1900**, 2614.

**CURRIOMAN BAY, VA.**

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 117, 158; **81**, 158.

ENGINEER IN CHARGE. S. T. Abert, U. S. Agent, 1880. Report, **81**, 982.

**Plans.**

By S. T. Abert, 1881, for dredging channel through bar 2,050 f. long, 150 f. wide, and 11 f. deep at low water; estimate, $8,278, **81**, 983.

**Survey.**

Of mouth ordered by act of June 14, 1880; made, 1880, under direction of S. T. Abert, **81**, 982.

**CURRITUCK SOUND.** (See *Norfolk, Va.*)

**CURTIS BAY, PATAPSCO RIVER, MD.** (See *Baltimore Harbor.*)

**CUYAHOGA RIVER.** (See *Cleveland, Ohio, examination of old river bed at.*)

**CYPRESS BAYOU.** (See *Red River, Ark., La., and Tex.*)

**DAIRY FORK.** (See *Tualiton River.*)

**DAKOTA RIVER, N. DAK. AND S. DAK.** (See *James River.*)

**DALLES.** (See *Columbia River.*)

**DAN RIVER, N. C. AND VA.**

**Appropriations.**

1880, $10,000, **80**, 790.
1881, 8,000, **81**, 978.
1882, 7,500, **82**, 1056.
1884, 5,000, **84**, 1000.
1886, 20,000, **86**, 927.

Total, 50,500

**Commerce.**

Commercial importance of river and adjacent country, **79**, 653.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 75; **79**, 88; **80**, 116, 117; **81**, 157; **82**, 152; **83**, 159; **84**, 161; **85**, 151; **86**, 146; **87**, 112; **88**, 115; **89**, 133; **90**, 120.

ENGINEER IN CHARGE. S. T. Abert, U. S. C. E., 1878–90; **78**, 75. Reports, **79**, 652; **80**, 788, 794; **81**, 977; **82**, 1053; **83**, 830; **84**, 1000; **85**, 993; **86**, 925; **87**, 95; **88**, 838; **89**, 1023; **90**, 1083.

ASSISTANT. S. W. Evans. Report, **79**, 654.

**Operations.**

**1880–81.** Two derrick boats and 2 scows built; 281 c. y. solid rock blasted, 115 c. y. loose rock, sand, and gravel removed, **81**, 978.

**1881–82.** 2,590 c. y. solid rock blasted; 482 c. y. loose rock, sand, and gravel removed; 774 c. y. rock used in dams, **82**, 1054.

**1882–83.** 1,055 c. y. rock quarried for spur dams, **83**, 830.

**1883–84.** 680 c. y. rock and 28 c. y. gravel removed; 124 c. y. of rock quarried; **84**, 1000.

**1884–85.** 421 c. y. rock excavated; 789 c. y. rock quarried; 649 c. y. placed in dams, **85**, 994.

**1885–86.** 125 c. y. rock removed, **86**, 926.

**1886–87.** Improving shoals in progress between Long and Adams Island shoals, **87**, 954.

**1887–88.** 1,900 c. y. loose and blasted rock removed; 981 c. y. sand and gravel dredged from the channel; 497 l. f. spur dams completed, **88**, 839.

**1888–89.** 174 l. f. crib work built, 208 l. f. brush mats sunk, and 140 c. y. rock used in dam construction, **89**, 1023.

**Physical characteristics.**

General, **79**, 652
Floods, **79**, 652.
Agricultural interests, **79**, 653.
Minerals in vicinity, **79**, 654.

## DAN RIVER, N. C. AND VA.—Continued.

Description of obstructions, **79**, 655–665.

Detailed description of obstructions, **80**, 797.

**Plans.**

By S. T. Abert, improving river, bateau navigation Hairston's Ford to Danville, by dredging, rock excavating, and with dams, estimate, $32,718, **79**, 666–671.

**Projects.**

By S. T. Abert, 1879, channel 35 f. wide with a depth of 3 f. at l. w. for 77 miles by dredging, rock excavating, and locks and dams; estimate, $658,579.20, **79**, 666, 671; **80**, 788. Revised in 1880 for a channel 35 f. wide, with a depth of 1½ f. in pools and 2 f. in rapids without locks and dams; estimate, $52,000, **80**, 788. Increased $5,500 in 1886–87, **86**, 147; **87**, 954.

**Surveys.**

By S. W. Evans, 1878–79. Report, **79**, 652, 654.

From Danville to Clarksville, ordered by act of Mar. 3, 1879; made, 1880, under direction of S. T. Abert, **80**, 794.

Resurvey of Seven Shoals made, **86**, 926.

MAPS:

Profile, **86**, 927.

Madison to Danville, **87**, 954.

## D'ARBONNE AND CORNEY (CORNAY RIVER) BAYOUS, LA.

**Appropriations.**

1884, [a]$5,000, **85**, 1506.
1886, [a]2,000, **86**, 1357.
1888, [a]2,000, **88**, 1350.
1890, [a]2,000, **90**, 1880.
1892, 4,000, **92**, 1609.
1894, 3,000, **95**, 1916.

Total, 18,000

**Contract.**

**1885.** Emmick & Feith, removing obstructions, $197.50 per mile, **85**, 1506.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 227; **85**, 236; **86**, 232; **87**, 195, 203; **88**, 178; **89**, 209; **90**, 189; **91**, 240; **92**, 1609; **93**, 261; **94**, 242; **95**, 271.

ENGINEERS IN CHARGE:

Capt. A. M. Miller, 1884. Reports, **84**, 1372, 1376.

Capt. E. Bergland, 1884–86. Reports, **85**, 1505; **86**, 1356.

Capt. J. H. Willard, 1886–95. Reports, **87**, 1458, 1489; **88**, 1349; **89**, 1599; **90**, 1879; **91**, 1980; **92**, 1609; **93**, 2009; **94**, 1468; **95**, 1914.

ASSISTANTS:

T. M. Farrell. Report, **84**, 1372.
F. S. Burrows. Report, **84**, 1376.
J. R. Vaughan. Report, **95**, 1915.

**Obstructions.**

Underwriters concerned notified and ordered to remove a wreck, **95**, 1916.

**Operations.**

**1884–85.** Obstructions removed from 23 miles of channel, **85**, 1506.

**1886–87.** Obstructions removed from 17 miles of channel, **87**, 1458.

**1887–88.** 3,036 leaning trees and shore snags cut, 243 logs removed from the channel, and 12,880 s. y. brush and willows cut, **88**, 1350.

**1888–89.** 1,185 snags removed from channel, 3,540 trees cut and topped, and 3,746 s. y. brush cleared from banks, **89**, 1599.

**1889–90.** 600 logs and snags removed from the channel, 11,600 trees cut and topped on the banks, and 425 s. y. brush cut, **90**, 1880.

**1890–91.** 53 snags cleared from the channel; 565 shore snags and logs cut; 562 trees cleared from the banks, **91**, 1981.

**1891–92.** 2,138 snags and stumps cleared; 4,200 shore snags and logs removed; 12,450 s. y. brush and willows cut; 7 wrecks removed, **92**, 1609.

**1893–94.** Wrecks removed and about 10,000 snags and other obstructions removed from Bayou Corney. About 9,000 snags, etc., removed from other parts, and 3,725 s. y. brush and willows cut, **94**, 1470.

**Physical characteristics.**

Description of bayou, **84**, 1372. 1377; **95**, 1915.

Corney River, **87**, 1489.

**Projects.**

By Maj. Miller, 1883, for removing logs, snags, and similar obstructions from the bayou mouth to Stein Bluff, 42 miles; estimate, $15,000, **84**, 1376; **85**, 1506.

Capt. Willard, 1893, estimated it would require $6,000 to complete the work, the act of 1892 having extended the improvement above Stein Bluff to head of navigation at Cobb Landing, **93**, 2010.

**Surveys.**

Ordered by act of Aug. 2, 1882, made under the direction of Maj. Miller, **84**, 1372, 1376, 1380.

Examination (Corney River) ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Willard (report unfavorable), **87**, 1489.

Examination of the bayou and its branches made, 1895, under the direction of Capt. Willard, **95**, 1915.

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[a] D'Arbonne Bayou.

## DARBY CREEK, PA.

**Commerce.**
Small, **87**, 823.

**Engineers.**
CHIEF OF ENGINEERS. Report, **87**, 86.

ENGINEER IN CHARGE. Lt. Col. H. M. Robert. Report, **87**, 822.

**Physical characteristics.**
Description of creek; probable lack of permanence of a channel, **87**, 822.

**Survey.**
Examination ordered by act of Aug. 4, 1886, made, 1886, under direction of Lt. Col. Robert (report unfavorable), **87**, 822.

## DARDANELLE, ARK. (See *Arkansas River.*)

## DARIEN HARBOR, GA. (See *Altamaha River.*)

**Appropriations.**
1878, $8,000, **78**, 78.
1890, 25,000, **91**, 1529.
1892, 25,000, **92**, 1259.
1894, 25,000, **95**, 1474.
1896, 20,000, **96**, 1255.
1899, 10,000, **99**, 1575

Total, 113,000.

**Commerce.**
Important, **85**, 1238–1242.
In 1892–93 it was valued at $1,500,000, **93**, 1558; in 1897 at about $1,090,000, **98**, 1304; 1898–99, at $2,500,000, **99**, 1575; 1899–1900, at $920,382, **1900**, 1936.

**Contracts.**
**1878.** American Dredging Co., dredging, 14⅜ cents per c. y., **79**, 764.
**1891.** P. S. Ross, dredging, 23 cents per c. y., **91**, 1530.
**1892.** Atlantic Contracting Co., spur dam work; fascines, 89 cents per c. y.; pile work, $1.40 per l. f.; fender piles, $50 per cluster; sawed timber, $25 per 1,000 f. b. m.; iron bolts, 9 cents per pound; riprap stone, $1.30 per c. y. ($15,185), **93**, 1559.
**1895.** W. T. Gaynor, mattresses, $1 per s. y.; fascines, $1.65 per c. y.; pile work, $1.50 per l. f.; fender piles, $50 per cluster; tie piles, $20 per group; sawed timber, $25 per M f., b. m.; iron bolts, 5 cents per pound; riprap stone, $3.05 per c. y. ($48,000), **95**, 1475.
**1896.** R. R. Moore, dredging, 12 cents per c. y. ($9,000), **97**, 1511.
**1900.** P. S. Ross, dredging, 13.7 cents per c. y. ($7,535), **1900**, 1937.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 78; **79**, 97; **85**, 191; **91**, 180; **92**, 177; **93**, 193; **94**, 177; **95**, 202; **96**, 180; **97**, 229; **99**, 260; **1900**, 297.

ENGINEERS IN CHARGE:
Lt. Col. Q. A. Gillmore. Reports, **78**, 579; **79**, 763; **85**, 1234, 1237.
Capt. O. M. Carter, 1890–97. Reports, **91**, 1528; **92**, 1257; **93**, 1556; **94**, 1166; **95**, 1473; **96**, 1253; **97**, 1508.
Capt. C. E. Gillette, 1898–. Reports, **98**, 1303; **99**, 1574; **1900**, 1935.

ASSISTANTS:
S. L. Fremont, **79**, 764.
Capt. T. N. Bailey. Reports, **85**, 1236; 1239.

**Operations.**
**1878–79.** Channels 50 f. by 10 f. at m. l. w., with an aggregate length of 500 y., dredged through shoals in Darien River north of Generals Island; channel 75 f. by 14 f. by 500 y. in North River below Union Island sawmills; and at the confluence of Darien and North rivers channel deepened 8 f. to 12 f. and widened to 75 f. Removal of 51,041 c. y., securing an average increase in depth of from 2 f. to 4 f., **79**, 97, 764.
**1890–91.** 13,194 c. y. dredged, **91**, 1528.
**1891–92.** 73,445 c. y. dredged, **92**, 1258.
**1892–93.** 1,200 piles driven; 15,068 c. y. fascines, 59,290 f. B. M. sawed timber, and 6,094 pounds of iron bolts used in the construction of 24 spur dams, **93**, 1557.
**1894–95.** 400 piles driven; 10,208 c. y. fascines, 683 c. y. riprap stone, 18,651 f. B. M. sawed timber, and 1,556 pounds iron bolts used in the construction of spur dams, **95**, 1474.
**1896–97.** 117,143 c. y. dredged, **97**, 1509.
**1897–98.** A wreck and a raft of logs removed from the channel, **98**, 1304. 11,358 c. y. dredged, **98**, 1314.
**1899–1900.** 69,790 c. y. dredged, **1900**, 1936.

**Physical characteristics.**
Description, **78**, 579; **85**, 1235, 1237, 1241.

**Projects.**
By Lt. Col. Gilmore, 1878, for removing shoal in Back River between Commodore and Wolf Islands, **78**, 78, 579.
By Col. Gillmore, 1885, formation of a channel, about 10 miles, between Darien and Doboy, through the shoals below Darien, 12 f. deep at low water, the channel to be obtained by dredging and maintained by the construction of wing dams at five of the shoals; estimate, $170,000, **85**, 1238, 1242; **91**, 1528.

**Surveys.**
Ordered by act of July 5, 1884, made under direction of Col. Gillmore, **85**, 1237.
Examination made, 1894, **94**, 1167; and a detailed survey, 1896–97, by Capt. Carter, **97**, 1509.
MAPS. **93**, 1560; **95**, 1476; **99**, 1576.

## DAVIS ISLAND DAM. (See *Ohio River.*)

## DAUPHIN ISLAND, ALA. (See *Pass au Heron.*)

## DEAL'S ISLAND, MD. (Lower Thoroughfare.)

**Appropriation.**
1881, $5,000, **81**, 884.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 111; **81**, 138, 150; **82**, 133; **83**, 138.

ENGINEER IN CHARGE. Lt. Col. W. P. Craighill, 1879–83. Reports, **81**, 882; **82**, 853; **83**, 679.

ASSISTANT. G. W. Parsons. Report, **81**, 883.

**Contract.**
**1881.** D. Constantine, dredging, 27 cents per c. y., **81**, 884.

**Operations.**
**1881–82.** 16,561 c. y. dredged, **82**, 854.

**Plans.**
By Lt. Col. Craighill, 1881, protecting channel near its mouth by riprap dike. Estimate, $15,000 to $20,000, **81**, 883.

**Projects.**
By Lt. Col. Craighill, 1881, excavating channel 100 f. wide and 7 f. deep at mean low water, from Tangier Sound, by the wharves of Daniel and of Vetra & Son, with turning basin at upper end. Estimate, $10,000, **81**, 882.

**Surveys.**
Of lower thoroughfare between Deal's and Little Deals Island, ordered by act of June 14, 1880, made 1880, under direction of Lt. Col. Craighill, **81**, 883.

## DEALS ISLAND, MD. (Upper Thoroughfare.)

**Appropriation.**
1882, $5,000, **82**, 855.

**Commerce.**
Commercial statistics, **82**, 855; **86**, 870.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **81**, 150; **82**, 138; **84**, 145; **85**, 139; **86**, 132; **87**, 96.

ENGINEERS IN CHARGE.
Lt. Col. W. P. Craighill, 1882–84. Reports, **82**, 855; **83**, 679; **84**, 903.
W. F. Smith, U. S. Agent, 1884–88. Reports, **85**, 889; **86**, 870; **87**, 846; **88**, 751.

ASSISTANT. G. W. Parsons. Report, **82**, 856.

**Projects.**
By Lt. Col. Craighill, 1882, harbor of refuge for small vessels and a landing place for steamers by dredging an anchorage basin with an approach from deep water with breakwater to protect the dredged channel from filling. Estimate, $20,000, **82**, 856; **83**, 680.

**Surveys.**
Upper thoroughfare between island and mainland; ordered by act of June 14, 1880, made under direction of Lt. Col. Craighill, **82**, 856.

## DEAL TO SEABRIGHT. (See *Long Branch Harbor, N. J.*)

## DEEP CREEK BRANCH OF ELIZABETH RIVER, VA.[a] (See *Elizabeth River, Va.*)

## DEEP RIVER, N. C. (See *Cape Fear, etc.*)

## DEEP RIVER, WASH., including Skamokawa River. (See *Crooked River.*)

**Engineers.**
CHIEF OF ENGINEERS. Report, **91**, 420.

ENGINEER IN CHARGE. Maj. T. H. Handbury, 1890. Report, **91**, 3378.

**Physical characteristics.**
Description of, **91**, 3378.

**Survey.**
Examination ordered by act of Sept. 19, 1890, made under direction of Maj. Handbury (report unfavorable), **91**, 3378.

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[a] Survey—Report Nov. 12, 1829, estimate, $29,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## DEER CREEK, MISS.

**Commerce.**

Important, **85**, 1539.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 244.

ENGINEER IN CHARGE. Capt. E. Bergland. Report, **85**, 1538.

ASSISTANT. F. S. Burrows. Report, **85**, 1540.

**Obstructions.**

Railroad and highway bridges without draws, **85**, 1539, 1543.

**Physical characteristics.**

Description of, **85**, 1538, 1540.

**Plans.**

In 1884 the stream worthy of improvement if the artificial obstructions were removed, creek could be cleared of logs and similar obstructions at a cost of $13,563, **85**, 1539, 1544.

**Survey.** (See *Plans.*)

Examination ordered by act of July 5, 1884, made under the direction of Capt. Bergland, **85**, 1538.

## DEER ISLAND, DEER AND LOVELLS ISLANDS. (See *Boston Harbor.*)

## DE GLAISE (DE GLAIZE) BAYOU, LA. (See *Des Glaises.*)

**Commerce.**

Benefit of improvement, **80**, 1176, 1178.

**Engineers.**

CHIEF OF ENGINEERS. Report, **80**, 145.

ENGINEER IN CHARGE. Maj. Howell, Report, **80**, 1176.

ASSISTANT. H. S. Douglass. Report, **80**, 1176.

**Physical characteristics.**

Bayou described, **80**, 1176.

**Plans.**

By Maj. Howell, 1879, for improving bayou, removing trees, logs, and brush; estimate, $9,540.

The Bayou not susceptible of permanent improvement, **80**, 1176, 1178.

**Survey.**

Ordered by act of March 3, 1879, made under direction of Maj. Howell, 1879, **79**, 112; **80**, 1176.

## DELAWARE AND CHESAPEAKE CANAL. (See *Chesapeake Bay.*)

## DELAWARE AND RARITAN CANAL.[a]

## DELAWARE BAY. (See *Chesapeake to—.*)

## DELAWARE BAY, DEL. (Harbor of refuge in).

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $5,000, | **96**, 924. |
| 1897, | 394,334, | **97**, 1217 |
| 1898, | 800,000, | **98**, 1096. |
| 1899, | 377,000, | **99**, 1355. |
| 1900, | 450,000, | **1900**, 1577 |

Total, $2,026,334

**Commerce.**

Commerce that would use the harbor important, **97**, 1217.

**Contracts.**

**1896.** Hughes Bros. & Bangs, breakwater construction, stone $1.18⅜ per t., ($1,638,795.33), **97**, 1218.

**1900.** Hughes Bros. & Bangs, constructing stone ice piers, $2.25 per t. ($145,125), **1900**, 1578.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 119; **92**, 119; **96**, 118; **97**, 149; **98**, 152; **99**, 173; **1900**, 197.

BOARD OF ENGINEERS. Convened at Philadelphia, Pa., Dec. 11, 1890, by S. O. No. 66, to examine and report upon a proposed national harbor of refuge for deep-draft vessels near the mouth of Delaware Bay. Reports, **91**, 1120; **92**, 941. (Col. Craighill, Maj. Raymond, and Capt. Bixby.)

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1890–. Reports, **96**, 924; **97**, 1216; (Lt. Col.) **98**, 1096; **99**, 1354; **1900**, 1576.

**Operations.**

**1896–97.** Soundings made to ascertain the exact character of the bottom; 9,035 t. stone were deposited, **97**, 1216, 1217.

**1897–98.** 289,709 t. stone deposited, **98**, 1096.

**1898–99.** 450,460 t. stone placed, **99**, 1354.

**1899–1900.** 345,895 t. stone placed, **1900**, 1576.

**Projects.**

By Board of Engineers, 1892, national harbor of refuge for deep-draft vessels, by constructing stone breakwater 1½ m.

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[a] Examination—Report (indefinite) February 2, 1825. (H. Doc. No. 482, 55th Cong. 2d sess.)

## DELAWARE BAY, DEL. (Harbor of refuge in)—Continued.

long off Cape Henlopen, Del., and for ice piers to protect the harbor from ice flowing down the river; estimate, $4,665,000, **92**, 942, 943; **96**, 924.

By Maj. Raymond, 1896, constructing piers after a part of the breakwater had been built, **97**, 1216.

By Lt. Col. Raymond, 1900, row of ten ice piers across the upper end of the harbor to protect it from ice descending the bay, **1900**, 1577.

**Surveys.** (See *Board of Engineers.*)

MAPS. **99**, 1354.

## DELAWARE BAY (Ice harbor at head of). (See *Listons Tree Point.*)

**Appropriation.**

1882, $25,000, **82**, 787.

**Contract.**

**1883.** American Dredging Co., removing ice piers at Reedy Island, **83**, 619.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 93, 98; **81**, 129; **82**, 125; **83**, 119; **84**, 129; **85**, 121; **86**, 118; **87**, 80; **88**, 80; **89**, 98; **90**, 89; **91**, 113; **92**, 115; **93**, 123; **94**, 112; **95**, 126; **96**, 115.

ENGINEERS IN CHARGE:

Col. J. N. Macomb, 1880–82. Report, **80**, 611.

Capt. W. Ludlow, 1882–83. Report, **82**, 784.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 618.

Maj. W. H. Heuer, 1884–85. Reports, **84**, 817; **85**, 841.

Lt. Col. H. M. Robert, 1885–90. Reports, **85**, 840; **86**, 834; **87**, 804; **88**, 704; **89**, 868.

Maj. C. W. Raymond, 1890–. Reports, **90**, 887; **91**, 1072; **92**, 930; **93**, 1169; **94**, 849; **95**, 1062; **96**, 919.

ASSISTANT. A. Stierle. Reports, **83**, 619; **84**, 817; **85**, 842.

**Physical characteristics.**

Tide-gauge observations at Port Penn and Listons Point, from Aug. 25 to Oct. 19, 1883, **84**, 823.

Borings, 1883, **84**, 824.

Flood and ebb current surface velocities, 1883, **84**, 825.

**Plans.**

By Capt. Ludlow, 1880, ice harbor, protecting about 9 acres, near Listons Bay; to consist of an iron substructure of screw piles carrying a wooden superstructure; estimate, $200,000 to $250,000, **80**, 613; **81**, 847.

Plan modified in 1882; estimate, $406,090.47, **82**, 785, 787.

Consideration of plan of ice harbor near Listons Point, **84**, 817–822; **85**, 841–845; estimate, $308,800, **85**, 845.

In 1885 Lt. Col. Robert considered the plans hitherto proposed defective, and recommended that the matter remain for the present in abeyance, **85**, 841; **86**, 836. Suggesting a consideration of the use of an ice breaker of floating pontoons heavily anchored in place of the previously proposed structures, **86**, 836; **87**, 804.

Maj. Raymond reports, 1890, that the construction of an ice harbor at the head of Delaware Bay should be deferred to await the completion of the improved ship channel between Philadelphia and the sea. Estimated cost of ice harbor from $400,000 to $600,000, **90**, 887; **91**, 1073; **92**, 931.

**Survey.**

Ordered by act of June 14, 1880, **81**, 846; **83**, 619; **84**, 817; **85**, 842.

## DELAWARE BAY TO CHINCOTEAGUE BAY. (See *Chincoteague Bay to Delaware Bay, Inland Navigation Between.*)

## DELAWARE BREAKWATER, DEL.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1822, | $22,700.00, | act May 7. |
| 1828, | 250,000.00, | **66**, iii, 31. |
| 1830, | 162,000.00, | **66**, iii, 31. |
| 1831, | 208,000.00, | **66**, iii, 31. |
| 1832, | 270,000.00, | **66**, iii, 31. |
| 1833, | 270,000.00, | **66**, iii, 31. |
| 1834, | 270,000.00, | **66**, iii, 31. |
| 1835, | 100,000.00, | **66**, iii, 31. |
| 1836, | [b] 1,000.00, | act July 2 (survey). |
| 1836, | 100,000.00, | **66**, iii, 31. |
| 1837, | 141,000.00, | **66**, iii, 31. |
| 1838, | 150,000.00, | **66**, iii, 31. |
| 1852, | 30,000.00, | **66**, iii, 31. |
| 1863, | 100,000.00, | act Feb. 20. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1864, | $100,000.00, | act July 2. |
| 1866, | 107,910.00, | **66**, iii, 31. |
| 1867, | 109,493.70, | act Mar. 2. |
| 1882, | 125,000.00, | **82**, 792. |
| 1884, | 75,000.00, | **84**, 845. |
| 1886, | 56,250.00, | **86**, 840. |
| 1888, | 100,000.00, | **88**, 708. |
| 1890, | 80,000.00, | **90**, 891. |
| 1892, | 50,000.00, | **92**, 935. |
| 1894, | 50,000.00, | **95**, 1066. |
| 1896, | 80,000.00, | **96**, 923. |
| Total, | 3,008,353.70 | |

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[a] Delaware Breakwater Harbor, Del.: Survey—Report Oct. 8, 1853, estimate $750,000. Crow Shoal, N. J., for breakwater: Survey—Report Dec. 1, 1837, estimate $1,590,843.30. Breakwater at the Shears near Cape Henlopen, Del.: Surveys—Report July 14, 1823, estimates $222,508.98 and $2,326,627.17; report Feb. 2, 1829, estimate $2,216,950.46. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Crab Shoal.

## DELAWARE BREAKWATER, DEL.—Continued.

**Commerce.**

The shelter afforded inadequate to the requirements of commerce, **74**, ii, 146; **79**, 453.

Necessity for increased harbor area, **82**, 792.

Importance of the work, **88**, 707.

**Contracts.**

**1867.** Barker & Bodwell, stone, $4.73 per t. Wm. H. Miller, labor, annulled. **67**, 433.

**1868.** A. O. & J. O. Deshong, jr., stone, $2.89 and $3.89 per t., **69**, 377, 380. J. C. Leiper, stone, $3.10 per perch, **69**, 377, 380.

**1882.** Eppinger & Russel, timber, **83**, 658. S. R. Cummings, creosoted timber, **83**, 658. Finley, Garret & Wilson, iron, **83**, 658. P. G. Field, iron, **83**, 658.

**1883.** W. H. Brown, granite, $3.23 per t., **83**, 659. H. L. Fearing, rope and cordage, **84**, 845.

**1884.** A. J. Howell, stone, $2.99 and $2.77½ per c. y., **84**, 846. C. A. Brown, stone, $1.74 per t., declined to enter into contract, **85**, 847, 848. Andrews & Locke, stone, $1.99 per t., **85**, 848.

**1885.** W. M. Field, stone, $2.24 per t., **86**, 841.

**1886.** W. M. Field, stone, $2.10 per t., **87**, 807.

**1888.** Brandywine Granite Co., furnishing and placing random stone, $2.23 per t., **89**, 873.

**1891.** Brandywine Granite Co., furnishing and placing random stone, $2.17 per t., **91**, 1077.

**1892.** Brandywine Granite Co., stone, $2.17 and $3.20 per t., ($48,552.92), **93**, 1172.

**1894.** G. W. Andrews, stone, $2.62 per t. ($29,475), **95**, 1066.

**1896.** Open market agreements, **96**, 922. J. F. Donovan, stone, $2.33 per t. ($55,920), **97**, 1215.

**Documents.** (Not printed in reports.)

H. Doc. 1, 33d Cong., 1st sess., **66**, 3; and all detailed reports prior to Maj. J. G. Barnard's, dated Oct. 8, 1853.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 3, ii, 30, 41, iii, 21, 22, 31, iv, 227; **67**, 42; **68**, 62; **69**, 53; **70**, 70; **71**, 77; **72**, 74, 777; **73**, 83; **76**, 61; **77**, 56; **78**, 62; **79**, 74, 455; **80**, 97; **81**, 127; **82**, 125; **83**, 129; **84**, 137; **85**, 122; **86**, 119; **87**, 81; **88**, 81; **89**, 100; **90**, 90; **91**, 115; **92**, 116; **93**, 125; **94**, 114; **95**, 127; **96**, 116; **97**, 148; **98**, 151; **99**, 172; **1900**, 196.

BOARDS OF ENGINEERS:

**1834.** Board of survey consider the subject of the formation of shoals and modification of project; recommended numerous careful and systematic observations of the force and direction of the currents, and no change in project, **66**, iv, 228, 229.

**1871.** Convened at Philadelphia and recommend further surveys.

**1872.** Reassembled May 12, and recommended closing gap between the breakwater and ice-breaker; estimate, $1,314,200. Report, **72**, 755. Lt. Col. Kurtz dissented. Reports, **72**, 757; **71**, 672, 678. (Col. Woodruff, Lt. Cols. Wright and Newton, and Maj. Craighill.)

ENGINEERS IN CHARGE:

Maj. R. Delafield, 1836, **73**, 883.

Lt. T. B. Linnard, 1839, **73**, 883.

Maj. H. Bache, 1839–53, **66**, iv, 227, 229; **72**, 777, 778; **73**, 83.

Maj. J. G. Barnard, 1853, **66**, iv, 227. Report, **73**, 878.

Col. J. D. Graham, 1864–66. Reports, **66**, 37, 40.

Maj. C. S. Stewart, 1866–70, **66**, ii, 41. Reports, **66**, iv, 226; **67**, 430, 432; **68**, 694; **69**, 377.

Lt. Col. J. D. Kurtz, 1870; **70**, 70. Reports, **70**, 422; **71**, 663; **72**, 753; **76**, 278; **77**, 269.

Capt. Wm. Ludlow, in temporary charge, 1877, **78**, 431. Report, **79**, 457.

Col. J. N. Macomb, 1877–81. Reports, **78**, 443; **79**, 453; **80**, 610; **81**, 820.

Capt. W. Ludlow, 1881–82. Report, **82**, 791.

Lt. Col. G. Weitzel, 1882–84. Report, **83**, 656.

Maj. W. H. Heuer, 1884–85. Report, **84**, 845.

Lt. Col. H. M. Robert, 1885–90. Reports, **85**, 846; **86**, 839; **87**, 805; **88**, 707; **89**, 871; **90**, 891.

Maj. C. W. Raymond, 1890–. Reports, **90**, 889; **91**, 1075, 1078; **92**, 933; **93**, 1172; **94**, 852; **95**, 1064; **96**, 922; **97**, 1214; (Lt. Col.), **98**, 1094; **99**, 1345; (final report, 1346); **1900**, 1575.

ASSISTANTS:

Capt. M. R. Brown, **71**, 77; **72**, 74, 757; **73**, 79; **76**, 58.

Capt. Wm. Ludlow, **77**, 52. Report, **79**, 457

A. Stierle. Report, **81**, 821.

J. M. Stewart. Reports, **83**, 659; **84**, 846.

L. Y. Schermerhorn. Report, **90**, 894.

**Estimates.** (See *Plans* and *Projects*.)

For closing the gap by extending the ice breaker:

By Maj. Bache, 1843, $815,341, **66**, iv, 229; **73**, 883.

By Maj. Stewart, 1866, $1,502,245.61, **66**, iii, 23, iv, 230.

By Lt. Col. Kurtz, 1871, $1,944,950, **71**, 664.

To close the gap by extending the breakwater proper, connecting with the ice breaker, **71**, 664.

## DELAWARE BREAKWATER, DEL.—Continued.

By Maj. Bache, 1843, $551,635.10, **66**, iv, 229; **73**, 883.

By Maj. Stewart, 1866, $1,018,571.86, **66**, iii, 23, iv, 230.

By Board of Engineers, 1872, $1,314,200, **72**, 74, 756.

By Lt. Col. Kurtz, 1871, $1,314,200, **71**, 664.

By Maj. Barnard, 1853, for this plan modified and completion of existing work, $500,000, **73**, 884.

To cover the gap by a detached work:

By Maj. Bache, 1843, $959,664.39, **66**, iv, 229; **73**, 883.

By Maj. Stewart, 1866, $1,762,078.07, **66**, iii, 23, iv, 230.

By Lt. Col. Kurtz, 1871, $2,278,000, **71**, 665.

By Maj. Barnard, 1853, for this plan modified and completion of the existing works, $750,000, **73**, 885.

By Maj. Bache, 1843, to complete existing work on present basis, $138,921, **73**, 884.

By Maj. Stewart, 1866, $109,493.79, **66**, iii, 23; **66**, iv, 230.

By Capt. William Ludlow, forming a basin by closing the gap, and a jetty to connect with the shore, $2,000,000, **79**, 461.

By Board of Engineers, closure of the gap, $600,000, **79**, 456.

By Col. Macomb, removal of eight wrecks, $28,000, **79**, 74, 454.

**Operations.**

**1866–67.** About 1,200 tons stone placed, completing 115 l. f. of breakwater superstructure. Total length completed about 2,000 f. **67**, 42,432.

**1867–68.** 8,100 tons stone put in position, 1,129 tons old stone removed and relaid, a gap of 210 f. closed in breakwater proper, and 228 f. of old work relaid and raised to proper level, **68**, 62, 63, 694, 695.

**1868–69.** 9,040 tons large stone for superstructures of breakwater and ice breaker placed in position, completing 217 l. f. of the former and 281 l. f. of the latter; 9,271 perches of stone applied to riprapping. Completion of breakwater and 646 f. of ice breaker **69**, 53, 377, 378.

**1869–70.** 10,698 tons large stone placed in superstructures, completing 120 f. of breakwater and 715 f. of the ice breaker; 122 tons stone of old superstructure reset and 2,192 perches riprap deposited. Total length of breakwater on top, 2,558 f.; of ice breaker, 1,353 f., **70**, 70, 422, 423.

**1882–83.** Constructing derrick, scows, and delivery of brush and creosoted piles, **83**, 659.

**1883–84.** Constructing mattress foundation in progress; 7,500 tons granite received, **84**, 846.

**1884–85.** 258 mattresses, 1,813 c. y. small and 1,198 tons large stone placed in foundation of work, and 3,000 tons stone delivered in gap, **85**, 846.

**1885–86.** 30,339 tons stone placed in gap, **86**, 839.

**1886–87.** 24,025 tons stone placed in gap, **87**, 805.

**1888–89.** 23,195 tons random stone placed in Delaware Breakwater gap, **89**, 871.

**1889–90.** 17,755 tons random stone placed in breakwater gap, **90**, 889.

**1890–91.** Quarrying of stone begun under contract, **91**, 1076.

**1891–92.** 34,022 tons granite placed in breakwater gap, **92**, 933.

**1892–93.** 18,746 tons stone deposited, **93**, 1172.

**1894–95.** 602 tons stone deposited, **95**, 1065.

**1895–96.** 8,016 tons stone deposited and a portion of an old wreck removed, **96**, 922.

**1896–97.** 17,078 tons stone deposited, **97**, 1214.

**1897–98.** 26,926 tons stone deposited and project completed, **98**, 1095.

**Physical characteristics.**

Description of, **71**, 77, 664, 670, 671, 683, 685, 686; **74**, ii, 147, 148; **99**, 1347.

Table of current velocities, **79**, 454.

General discussion, **79**, 458.

Ice formation in harbor, **81**, 821.

Changes of depth in harbor, **82**, 791.

Slopes of the breakwater, **86**, 840.

**Plans.** (See also *Estimates* and *Projects.*)

Lt. Col. Kurtz suggested the removal of the breakwater and ice breaker to the "Shears," **74**, ii, 148.

By Maj. Barnard, 1853, reducing the width of the top to 12 f., **73**, 884.

By Capt. William Ludlow, pile jetty from high-water mark to the 15-f. curve, and a number of small jetties perpendicular to the shore to arrest the movement of the cape, **79**, 460, 461.

**Private (corporate) work.**

The Western Union Telegraph Co. laid a cable to and opened an office on the breakwater in 1876, **76**, 278.

**Projects.** (See *Estimates* and *Plans.*)

The original project was submitted in 1828 by a board of commissioners appointed by Congress, and proposed the construction, in the concavity of the bay just inside of Cape Henlopen, of two massive works on the pierres perdues or riprap system, separated by an interval of 1,390 f.; the larger work, called the breakwater, to afford a safe anchorage during gales from the north and east, and the lesser, called the ice breaker, to pro-

## DELAWARE BREAKWATER, DEL.—Continued.

tect shipping against northeast gales and the heavy drifting ice in the bay, **66**, iv, 229; **73**, 881, 884; **79**, 453; **86**, 119.

This project was completed in 1869, under aggregate appropriations of $2,192,103.70, and resulted in the construction of a breakwater 2,558 f. long, and an ice breaker 1,359 f. long on top, **79**, 453; **86**, 119, 840.

The board of engineers of 1871 and 1879 recommended the closure of the interval between the breakwater and ice breaker by a work similar to those already built; estimate, $600,000 to $1,314,200, **72**, 756; **79**, 456.

By Capt. Ludlow, 1882, closing the gap between the breakwater and ice breaker, by a random-stone foundation carrying a concrete superstructure; the foundation to be brought to a height of 12 f. below m. l. w., with a top width of 48 f.; the concrete superstructure to have a bottom width of 24 f., a top width of 12 f., and to rise 12 f. above m. l. w.; estimate, $675,000, **82**, 792; **86**, 119.

In 1883 a brush-mattress foundation under the random-stone superstructure was adopted, **83**, 130, 659; **84**, 845.

In 1884 the pile bridge forming a part of the project of 1882 was abolished, **84**, 846; **85**, 122, 847; **87**, 81.

Causes for probable increase in cost as originally estimated, **87**, 806.

By Lt. Col. Robert, 1890, completing Delaware Breakwater by a substructure of rubble stone and a superstructure of concrete; the rubble mound to have side slopes of 1 vertical to 2 horizontal on the sea face, and 1 vertical to 1½ horizontal on the harbor face; its top to be 62 f. wide and 15 f. below m. l. w.; the superstructure to have a cross section of 27 f. height and 27 f. width, its base being 15 f. below m. l. w., and its top 7½ f. above m. l. w.; the material to be concrete blocks up to about 2 f. above high water, the topping, after the blocks have settled, to be a mass of concrete; the foot of the superstructure to be protected on the sea face by 4-ton blocks of stone; estimate, $500,000, **90**, 893.

In 1891 the revised project of Maj. Raymond provided for a rubble mound, to be raised to the level of m. l. w., with a width of 40 f. at that level, and a superstructure above low water, 14 f. high and 20 f. wide on top, to be formed by heavy stone laid in position, the interior spaces to be filled with rubble; estimate, $400,000, **91**, 1083.

Detailed description of completed work, **99**, 1346.

**Surveys.**

Numerous early, **73**, 882.

Conclusions of board of survey, 1834, **73**, 881, 883; **66**, iv, 228. Under direction of Lt. Col. Kurtz, by Lt. M. R. Brown, 1871–72, **72**, 75, 756. By Capt. W. Ludlow. Report, **79**, 457.

Ordered by act of March 3, 1881, **83**, 130; made under direction of Capt. Ludlow, **82**, 792.

Examination made by Maj. Raymond, 1894, **94**, 852.

Survey made, 1897 and 1898, by Maj. Raymond, **98**, 1095.

Examination made, 1899, by Lt. Col. Raymond, **99**, 1345.

MAPS.

List, relating to the work and of the vicinity, **72**, 757.

Of breakwater and bay, **66**, i.

Of the harbor showing location of current observations and proposed improvement, **79**, 454. (See also survey of Crow Shoals, Delaware Bay, 1873, under direction of Lt. Col. Kurtz, by F. M. Eppley. Report, **74**, ii, 146–154.)

**99**, 1352.

## DELAWARE BREAKWATER HARBOR AND DELAWARE BAY AND RIVER (Wrecks, removal of).

**Appropriation.**

Jan. 23, 1880, $25,000, **80**, 607.

**Contracts.**

**1880.** G. W. Townsend, $12,200 (annulled), **81**, 822.

**1881.** McDonald & Cuming, $17,250, **81**, 823.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **68**, 64, 710; **80**, 97; **81**, 128; **82**, 125.

ENGINEERS IN CHARGE.

Lt. Col. C. S. Stewart. Report, **68**, 710.

Col. J. N. Macomb. Reports, **80**, 607; **81**, 822.

Capt. Wm. Ludlow. Report, **82**, 797.

**Estimates.**

By Lt. Col. Stewart, for removing wreck of brig in vicinity of Listons Tree and Duck Riv [illegible] 00 or $7,000, **68**, 711.

**Projects.**

Ten vessels foundered at their moorings in the overcrowded breakwater harbor during a storm in 1877. Their hulls began aiding shoaling, and Congress was appealed to for funds. Removal of wreck (not found) from Crossover Ledge Light was included. **80**, 607.

Removal of other wrecks in parts of the bay and river done in subsequent years with the balance of the money.

**Surveys.**

Examinations made by Lt. Col. Stewart, in compliance with instructions from the Chief of Engineers, based upon the petitions of pilots and the board of underwriters of the city of Philadelphia to the Secretary of the Treasury, and referred by him to the Secretary of War, **68**, 710.

## DELAWARE CANAL. (See *Chesapeake and—; Salem River, N. J.*)

## DELAWARE LINE (through Worcester County, Md.) TO CHINCOTEAGUE INLET, VA. (Canal.)

**Appropriations.** (See *Expenditures.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **72**, 78; **73**, 83.

ENGINEER IN CHARGE. Lt. Col. J. D. Kurtz, 1872. Reports, **72**, 791; **73**, 892.

ASSISTANT. F. M. Eppley. Report, **73**, 894.

**Expenditures.**

For survey, $2,170.64, **73**, 894.

**Plans.**

By Mr. Eppley, canal 2,000 f. long by 125 f. wide by 6 f. deep, from the bay to the ocean, sheet-pile wing-dams in the bay 950 f. long, and dredging Massays Shoals; estimate, $62,714.55, **73**, 897. Dimensions of the canal modified by Lt. Col. Kurtz to 250 f. wide by 7 f. deep; estimate increased to $120,605, **73**, 899.

**Survey.**

In 1872, for inlet at the "Hommocks," Md., under the direction of Lt. Col. Kurtz, by F. M. Eppley. Reports, **72**, 791; **73**, 892, 894.

## DELAWARE RIVER, N. J. AND PA.[a] (See also *Chester Harbor, Delaware River at Philadelphia, Marcus Hook Harbor, Pa., New Castle Harbor, Wilmington Harbor, Del., Listons Tree Point*, and *Reedy Island, Del.*

**Appropriations.**

| | | |
|---|---|---|
| 1802, | [b] $30,000.00, | act April 6. |
| 1806, | [b] 448.71, | act April 18. |
| 1836, | [c] 15,000.00, | act July 4. |
| 1872, | [d] 10,000.00, | **72**, 77. |
| 1873, | [c] 50,000.00, | **73**, 82. |
| 1873, | [d] 15,000.00, | **73**, 82. |
| 1873, | *[f] 50,000.00, | **73**, 82. |
| 1874, | [d] 10,000.00, | **74**, 92. |
| 1874, | [c] 50,000.00, | **74**, 92. |
| 1875, | [c] 20,000.00, | **75**, ii, 190. |
| 1875, | [e] 10,000.00, | **75**, ii, 193. |
| 1876, | †[g] 40,000.00, | **76**, 60, 275. |
| 1878, | [e] 10,000.00, | **78**, 61. |
| 1878, | [h] 100,000.00, | **78**, 61. |
| 1879, | [e] 6,000.00, | **79**, 70. |
| 1879, | [h] 45,000.00, | **79**, 71. |
| 1879, | [i] 50,000.00, | **79**, 71. |
| 1879, | [j] 100,000.00, | **79**, 71. |
| 1880, | [e] 10,000.00, | **80**, 562. |
| | [h] 85,000.00, | **80**, 569. |
| | [i] 40,000.00, | **80**, 578. |
| | [j] 100,000.00, | **80**, 580. |
| 1881, | [k] 10,000.00, | **81**, 735. |
| | [h] 100,000.00, | **81**, 745. |
| | [i] 40,000.00, | **81**, 755. |
| | [j] 100,000.00, | **81**, 760. |
| 1882, | [k] 10,000.00, | **82**, 727. |
| | [h] 136,000.00, | **82**, 737. |
| | [i] 40,000.00, | **82**, 742. |
| | [j] 100,000.00, | **82**, 745. |
| 1884, | 200,000.00, | **85**, 799. |
| 1886, | 210,000.00, | **86**, 808. |
| 1888, | 250,000.00, | **88**, 675. |
| 1890, | [l] 240,000.00, | **90**, 875. |
| 1892, | $50,000.00, | **92**, 904. |
| 1894, | 170,000.00, | **95**, 1027. |
| 1896, | 500,000.00, | **96**, 887. |
| 1899, | 300,000.00, | **99**, 1322. |
| 1900, | 270,500.00, | **1900**, 1561. |

Total, 3,572,948.71

**Commerce.**

Of city of Trenton, **71**, 708.

Lumber business of the upper river, **73**, 902, 922.

Losses annually to lumbermen, **73**, 916.

Commerce of Philadelphia, **79**, 423, 428–431.

List of vessels sunk in Delaware River and Bay, **81**, 746.

Draft of vessels seeking port of Philadelphia, **85**, 804.

Commercial requirements between Philadelphia and Trenton, **90**, 880.

**Contracts.**

AT FORT MIFFLIN BAR:

**1873.** Albany Dredging Co., dredging 140,000 c. y., at 21.9 cents per c. y., **73**, 872.

**1874.** American Dredging Co., dredging, 19 cents per c. y., **74**, ii, 141.

**1875.** American Dredging Co., dredging, 22½ cents per c. y., **75**, ii, 190.

**1876.** American Dredging Co., dredging, 16 cents per c. y., **77**, 267.

**1878.** Morris & Cummings, dredging, 15 cents per c. y., **79**, 428.

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[a] Delaware River: Survey—Report June 20, 1832, estimate $25,715.80. Chester piers: Survey—Report Nov. 20, 1826, papers not on file. Piers at Port Penn, Marcushook, and Fort Mifflin: Examination—Report May 31, 1827, unknown, papers not on file. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Piers. [c] Fort Mifflin Bar. [d] Bordentown to Trenton. [e] Trenton to Whitehill. [f] Horseshoe Shoals. [g] Pettys Island to mouth. [h] Below Bridesburg. [i] Schooner ledge. [j] Cherry Island Flats.

* Transferred by act of Mar. 3, 1875, to the improvement of the river between Pettys Island and its mouth, 75, ii, 191.

† Of which $35,000 was allotted to Fort Mifflin Bar, 77, 265.

[k] Trenton to Bridesburg.

[l] Part of $250,000, of which $10,000 was for Rancocas River.

## DELAWARE RIVER, N. J. AND PA.—Continued.

BETWEEN TRENTON AND BORDENTOWN AND WHITEHILL:

**1873.** E. M. Payne, dredging, 60,000 c. y., 28½ cents per c. y., **73**, 873.

**1874.** American Dredging Co., dredging, 16 cents per c. y., **74**, ii, 141

**1875.** William H. Beard, dredging, 18 cents per c. y., **75**, ii, 194.

**1878.** American Dredging Co., dredging, 14⅜ cents per c. y., **79**, 423.

BETWEEN TRENTON AND BRIDESBURG:

**1879.** J. V. Patten, dredging, 55 cents per c. y., **80**, 563.

**1880.** M. Herron, dredging, 22 cents per c. y., **81**, 735.

**1881.** M. Herron, dredging, 22 and 50 cents per c. y., **82**, 728.

**1882.** M. Herron, dredging, 40 and 50 cents per c. y., **83**, 574.

BELOW BRIDESBURG:

**1879.** G. F. Ferris, dredging, 26¾ cents per c. y., **80**, 570. F. B. Colton, dredging, 27.4 cents per c. y., **80**, 570.

**1880.** G. F. Ferris, dredging, 35 cents per c. y., **80**, 570. American Dredging Co., dredging, 39 and 46 cents per c. y., **81**, 747. F. Pidgeon, dredging, 33 and 39 cents per c. y., **81**, 747.

**1881.** American Dredging Co., dredging, 39, 41, and 58 cents per c. y., **82**, 738. National Dredging Co., dredging, 34½, 37, and 40 cents per c. y., **82**, 738.

**1882.** National Dredging Co., dredging, 40 cents per c. y., **82**, 738. Delaware and Chesapeake Improvement Co., dredging, 37 cents per c. y., **83**, 605. New York Steam Dredging Co., 54½ cents per c. y., **83**, 605. American Dredging Co., dredging, 35 cents per c. y., **83**, 605. New York Steam Dredging Co., dredging, 38 cents per c. y., **83**, 605. Delaware and Chesapeake Improvement Co., dredging, 23½ cents per c. y., **84**, 804.

AT SCHOONER LEDGE:

**1880.** Townsend & Trumbull, rock removal, $21 per c. y., **80**, 578. American Dredging Co., rock removal, $17 per c. y., **81**, 755.

**1881.** American Dredging Co., rock removal, $24 per c. y., **82**, 742.

**1882.** American Dredging Co., rock removal, $21 per c. y., **83**, 608.

AT CHERRY ISLAND FLATS:

**1879.** F. B. Colton, dredging, 23 cents per c. y., **80**, 580.

**1880.** National Dredging Co., dredging, 21.7 cents per c. y., **81**, 760.

**1881.** National Dredging Co., dredging, 21 cents per c. y., **82**, 745.

**1882.** National Dredging Co., dredging, 23 cents per c. y., **83**, 609.

BETWEEN TRENTON, N. J., AND THE MOUTH:

**1885.** American Dredging Co., dredging west of Pettys Island, 19¼ cents per c. y., **86**, 812. American Dredging Co., dredging at Mifflin Bar, 9½ cents per c. y., **86**, 812. E. D. Register, dike construction, Mifflin Bar, **86**, 812. Failure to complete contract and its annulment, **86**, 804. J. A. Bouker, dike construction at Fishers Point and Mifflin Bar, **86**, 812. R. Patterson & Sons, dike construction at Mifflin Bar, **86**, 812.

**1886.** R. W. Gibson, construction of Smiths Island revetment, **87**, 797. American Dredging Co., dredging at Smiths Island bar, 18 cents per c. y., **87**, 797. J. A. Bouker, furnishing stone for Smiths Island revetment, $1.83 per c. y., **87**, 797. American Dredging Co., dredging west of Pettys Island, 32 cents per c. y., **87**, 797. J. H. Ward, stone at Mifflin Bar dike, $1.09 per c. y., **87**, 797.

**1887.** M. W. Locke, dike construction at Reedy Island, **87**, 797. Comparison of cost of dredging by contract and hired labor, **81**, 757; **82**, 734.

**1888.** J. H. Ward, furnishing and placing stone in Mifflin Bar dike, $1.19 per c. y., **88**, 676. J. A. Bouker, furnishing and placing stone in Fishers Point dike, $1.49 per c. y., **89**, 860. American Dredging Co., dredging at Mifflin Bar, 18 cents per c. y., **89**, 859. Atlas Dredging Co., dredging at Bulkhead Shoal, 24 cents per c. y., **89**, 859. Davis & Irwin, 500 l. f. pile and stone dike at Fishers Point, $8,521.63, **89**, 860. Davis & Irwin, 500 l. f. of pile dike at Fishers Point, $5,379.75, **89**, 861. Brandywine Granite Co., brush and stone dike construction at Reedy Island; brush mattress, $1.55 per c. y., and stone, $1.45 per c. y., **88**, 676. E. H. Gaynor, brush and stone dike construction at Reedy Island; brush mattress, $1.25 per c. y., and stone, $1.30 per c. y., **89**, 860.

**1890.** W. T. Gaynor, 600 l. f. of pile and stone dike construction at Kinkora Bar, $9,003, **90**, 876. F. C. Somers, dredging at Kinkora Bar, 7.9 cents per c. y., **91**, 1026. C. McLean, dike construction at Bulkhead Bar, **92**, 902.

**1891.** I. H. Hathaway, pile and stone dike construction at Bulkhead Bar, $49,919, **91**, 1027.

**1892.** American Dredging Co., dredging, 9.7 cents per c. y., ($71,295), **93**, 1147.

**1894.** Brandywine Granite Co., dike repairing, $31,355, **94**, 829.

**1895.** American Dredging Co., dredging, 14 cents per c. y. ($2,800), **95**, 1028. Morris & Cumings Dredging Co., dredging, 11.9 cents per c. y., s. m. ($30,416.40), **95**, 1028. Brandywine Granite Co., dike repairing; timber at $75 per M f., iron work at 7 cents per pound, and stone at $1.19 per c. y., ($9,598), **95**, 1028. Delaware Construction Co., dike construction; mattresses at $1.45 per c. y., stone at $1.35

## DELAWARE RIVER, N. J. AND PA.—Continued.

and $1.05 per c. y. ($128,150). (Contract annulled 1896.) (Contractors were given $54,350.35 by act of June 3, 1896). **97**, 1193.

**1896.** Morris & Cumings Dredging Co., dredging, 7.9 cents per c. y. ($31,600), **97**, 1895.

**1897.** Morris & Cumings Dredging Co., dredging, $8\frac{9}{11}$ cents per c. y. ($264,545.45), **97**, 1195.

**1898.** P. H. Wilson, dredging, 30 cents per c. y. ($4,500), **98**, 1079.

**1899.** River and Harbor Improvement Co., dredging, $6\frac{7}{8}$ cents per c. y. ($72,187.50), **99**, 1323. P. S. Ross, incorporated, rock removal opposite Petty Island, $6.85 per c. y. ($44,518.15). Virginia Dredging Co., dredging, $5\frac{1}{2}$ and 6 cents per c. y. ($194,830); bulkhead construction (piles, timber, and iron), $180,450. **1900**, 1562.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 32, 71; **71**, 81; **72**, 77, 79; **73**, 82; **74**, 92; **75**, 98, 99; **76**, 60; **77**, 55; **78**, 61; **79**, 69–71; **80**, 91, 92, 93; **81**, 116, 117, 118, 119; **82**, 116, 117, 118, 119; **83**, 112, 113, 114, 115, 116; **84**, 122, 123, 124, 125, 126; **85**, 115, 116, 117, 118, 119, 811; **86**, 113, 114, 115, 825; **87**, 76; **88**, 76; **89**, 94; **90**, 84; **91**, 108; **92**, 110; **93**, 119; **94**, 108; **95**, 122, 132; **96**, 110; **97**, 142; **98**, 144, 156; **99**, 164; **1900**, 189, 207.

BOARDS OF ENGINEERS:

Convened at Philadelphia, Apr. 23, 1873, to consider Lt. Col. Kurtz's plan for prevention and removal of ice obstructions at Horseshoe Shoals. Considered that ice boats afford the most effective means of overcoming the difficulties of winter navigation; that the expedient of a ship canal is one that belongs rather to the shipping interests and property owners than to the General Government; and recommended the use of two lines of ice barriers, as proposed by Col. Kurtz, made of timber instead of iron, **73**, 875–878. (Col. Woodruff, Lt. Cols. Wright, Newton, and Kurtz, and Maj. Craighill.)

Constituted by S. O., No. 79, C. of E., 1879, to consider the improvement in progress at Bulkhead Shoals and Cherry Island Flats. Report, **80**, 575. The Board approve of plans in progress, and recommend that dredged material be placed on the submerged lands adjacent to the channels dredged, **80**, 567, 576. (Col. Macomb, Lt. Cols. Raynolds and Michler, and Capt. Ludlow.)

The Board of 1885, constituted by S. O., No. 117, C. of E., 1884, to examine and report upon the permanent improvement of the Delaware River and Bay, recommend the formation of a ship channel between Philadelphia and deep water in the bay not less than 600 f. wide and 26 f. deep at m. l. w., **85**, 822, 830. (Lt. Cols. Craighill and McFarland, and Majs. Gillespie and Heuer.)

Board reconvened Oct., 1885, to consider objections made by citizens of Camden to the construction of Fishers Point dike. Report, **86**, 822.

Convened at Philadelphia, Apr. 18, 1896, under instructions from the Chief of Engineers, dated Apr. 15, 1896, to consider the probable effects of dikes under construction at Liston Point and Reedy Island on navigation of Appoquinimink River and Blackbird Creek and on the navigability and sanitary condition of the Delaware River between the dikes and the Delaware shore. Report, **96**, 887. (Col. H. M. Robert, Col. P. C. Hains, and Maj. C. W. Raymond.)

Convened at Philadelphia, Aug. 10, 1896, by S. O., No. 19, dated July 28, 1896, to report on the project for dike between Reedy Island and Liston Point. Report, **97**, 1199. (Col. H. M. Robert, Col. P. C. Hains, and Maj. C. W. Raymond.)

Convened at Philadelphia, Apr. 10, 1899, by S. O., No. 16, dated Mar. 20, 1899, to make a further examination of the project for improving Delaware River from Trenton to its mouth, and report such modifications as might be deemed desirable. Report, **1900**, 1617. (Lt. Col. G. J. Lydecker, Lt. Col. C. W. Raymond, and Maj. W. H. Bixby.)

ENGINEERS IN CHARGE:

Lt. Col. J. D. Kurtz, 1870–77; **71**, 77. Reports, **71**, 704, 707; **72**, 783; **73**, 872, 899–929; **74**, ii, 140; **75**, ii, 189–193; **76**, 274; **77**, 265.

Col. J. N. Macomb, 1877–1881; **78**, 59. Reports, **78**, 439; **79**, 420, 485; **80**, 561, 563, 577, 579; **81**, 733, 736, 752, 756.

Capt. W. Ludlow, 1881–82. Reports, **82**, 725, 728, 740, 743.

Lt. Col. G. Weitzel, 1882–84. Reports, **83**, 594, 596, 607, 609.

Lt. T. L. Casey, March 19 to April 19, 1884, **84**, 792.

Maj. W. H. Heuer, 1884–85. Reports, **84**, 792, 794, 808, 809; **85**, 802.

Lt. Col. H. M. Robert, 1885–90. Reports, **85**, 798, 833, 834, 835, 836; **86**, 801, 820, 826, 828, 829; **87**, 786–799; **88**, 669; **89**, 847; **90**, 878.

Maj. C. W. Raymond, 1890–. Reports, **90**, 866; **91**, 1022; **92**, 900; **93**, 1142; **94**, 827; **95**, 1021, 1080; **96**, 877; **97**, 1192; (Lt. Col.) **98**, 1075, 1105; **99**, 1317; **1900**, 1557, 1615.

ASSISTANTS:

M. Merriam. Report, **73**, 900.

F. F. Weld, **73**, 900.

Capt. W. Ludlow, **78**, 59. Report, **79**, 434.

## DELAWARE RIVER, N. J. AND PA.—Continued.

Thomas Valentine. Reports, **78**, 439, 440; **83**, 601; **84**, 802, 803, 809, 810; **85**, 811.

A. H. Fisher, **79**, 421.

A. Stierle. Reports, **83**, 595, 598, 599; **84**, 792, 797, 800; **85**, 813.

J. J. Lee. Reports, **83**, 601, 602.

T. G. Locke. Report, **83**, 608.

J. H. Dager. Report, **83**, 610.

Lt. T. L. Casey. Report, **85**, 815.

E. A. Giesler. Report, **85**, 817.

**Estimates.** (See *Plans* and *Projects*.)

By M. Merriam, assistant engineer, for improvement between Trenton and Easton, $23,110.54, **73**, 917-921.

By Lt. Col. Kurtz, for the same, $25,922.33, **73**, 929.

By Lt. Col. Kurtz, for improvement between Trenton and Bordentown, at Periwig Island, $65,000 and $75,000, **71**, 81, 708; **74**, ii, 142; **76**, 276; **77**, 268.

By Lt. Col. Kurtz, for improvement at Horseshoe Shoals, for ice boats, $1,000,000, **72**, 78, 787; for ice barriers, $1,062,000, **72**, 78, 790, 791; for open cut or ship canal, $1,300,000, **72**, 78, 787, 788.

By Board of Engineers, for wooden ice barriers 8,000 f. in length, $211,435.18, **73**, 878.

By Lt. Col. Kurtz, for improvement at Bulkhead Shoals, $275,000, **75**, ii, 192.

By Col. Macomb, for various improvements between Trenton and Philadelphia, **79**, 422.

By Capt. Ludlow, for removal of Schooner Ledge to 24 f. water, $226,940, **79**, 435.

By Col. Macomb, for dredging at Cherry Island Flats, $304,000, **79**, 438.

**Legal proceedings.**

Injunction granted by State of New Jersey against construction of Fishers Point dike, **86**, 804, 806, 813, 815. Injunction removed by United States circuit court, **86**, 807.

**Legislation.**

By State of Pennsylvania, for improvement of the river between Trenton and Easton, **73**, 909, 927. By State of New Jersey for the same, **73**, 928.

**Operations.**

BETWEEN TRENTON AND BORDENTOWN AND WHITEHILL:

**1873-74.** Dredging 60,000 c. y. from Periwig Island Shoal, giving a cut 75 f. wide 6 f. deep, **74**, ii, 142; **75**, ii, 193.

**1874-75.** Width of channel increased to 125 f., **75**, ii, 193; **77**, 267.

**1878-79.** A channel cut at Bordentown 200 f. wide, 7 f. deep, **79**, 69, 421.

AT FORT MIFFLIN BAR:

**1873-74.** Dredging 140,000 c. y., **74**, ii, 140.

**1874-75.** Dredging 265,000 c. y., **75**, ii, 189.

**1875-76.** Dredging 125,016 c. y., **76**, 60. Work ceased Apr. 5, 1876, under the above title, and was continued under the appropriations for the Delaware River "between Pettys Island and its mouth," **76**, 60, 274; and "below Bridesburg," **78**, 61, 440.

**1875-76.** Dredging 96,221 c. y., **76**, 60, 274.

**1876-77.** Dredging 100,000 c. y., **77**, 55.

**1877-78.** Dredging 62,000 c. y. **78**, 61, 440.

**1878-79.** Dredging 98,000 c. y., **79**, 70, 426.

AT HORSESHOE SHOALS:

No operations, the experience during the winter of 1874-75 showing that the ice boats were amply sufficient to keep the navigation open. The unexpended balance ($49,500) to be used on the river between Petty's Island and its mouth, **75**, ii, 191; **76**, 274.

BETWEEN PETTY'S ISLAND AND THE MOUTH OF THE RIVER. (See also at *Fort Mifflin Bar, ante.*)

Work ordered by the Chief of Engineers, **75**, ii, 191.

**1875-76.** Dredging 98,000 c. y. at Bulkhead Shoals, and a sunken wreck removed from below Reedy's Island at cost of $900, **76**, 60, 274.

**1876-77.** Wreck removed below Horseshoe Buoy, **77**, 55.

BELOW BRIDESBURG. (See also *Mifflin Bar, ante.*)

**1877-78.** A wreck removed from the channel at Pea Patch Island, **78**, 61, 440.

**1878-79.** A gravel shoal off Christian street, Philadelphia, removed to 25 f. water, **79**, 70, 426.

AT SCHOONER LEDGE:

**1878-79.** Borings made, **79**, 433.

BETWEEN TRENTON AND BORDENTOWN AND WHITEHILL:

**1879-80.** Closing of Duck and Long Island Bar back channels with timber dikes filled with gravel, **80**, 561; **81**, 734. 12,760 c. y. dredged from channels at Bordentown and Periwig Island, **80**, 562.

**1880-81.** 47,645 c. y. dredged from channels at Bordentown; Duck and Long Island Bar dikes repaired, **81**, 734.

**1881-82.** 21,085 c. y. dredged from channel at Bordentown, **82**, 726.

**1882-83.** Repairs to Duck and Long Island Bar dikes; 11,428 c. y. dredged from channel at Bordentown, **83**, 595,

**1883-84.** 6,120 c. y. dredged from channel at Bordentown, **84**, 123, 793.

## DELAWARE RIVER, N. J. AND PA.—Continued.

Below Bridesburg:

**1879–80.** 48,132 c. y. dredged from channel west of Petty's Island, opposite Port Richmond, **80**, 564. 71,000 c. y. dredged from Mifflin Bar, **80**, 564. 5,000 c. y. dredged from Bulkhead Shoals, **80**, 565, 577.

**1880–81.** Channel 75 f. wide and 9 f. deep dredged across upper end of Five-Mile Bar, **81**, 736. 72,198 c. y. dredged from channel west of Petty's Island, **81**, 737. 10,000 c. y. dredged from channel across upper end of Smith's Island Bar, **81**, 737. 13,252 c. y. dredged from Mifflin Bar, **81**, 739.

**1881–82.** 6,500 c. y. dredged from channel at upper end of Petty's Island, **82**, 729. 38,869 c. y. dredged from channel at Port Richmond, **82**, 730. 13,000 c. y. dredged from channel across upper end of Smith's Island Bar, **82**, 731. 22,000 c. y. removed from Mifflin Bar, **82**, 732. 40,000 c. y. removed from Bulkhead Shoal, **82**, 733.

**1882–83.** 7,516 c. y. removed from channel at Port Richmond, **83**, 597, 598. 11,566 c. y. removed from bar at upper end of Petty's Island, **83**, 598. 135,194 c. y. removed from Mifflin Bar, **83**, 600. 67,119 c. y. removed from Bulkhead, Shoal, **83**, 601.

**1883–84.** 29,446 c. y. removed from channel at Port Richmond, **84**, 795. Aggregate of material removed at this point, 200,412 c. y. **84**, 798. 23,394 c. y. removed from Smith's Island Bar at upper end of island, **84**, 801. 80,154 c. y. removed from Mifflin Bar, **84**, 802. 111,281 c. y. removed from Bulkhead Shoal, **84**, 803.

**1884–85.** 16,372 c. y. removed from Smith's Island Bar, **85**, 834.

At Schooner Ledge:

**1879–80.** 1,386 c. y. of rock and bowlders and 2,309 c. y. of sand and gravel removed, **80**, 577.

**1880–81.** 476 c. y. of rock and bowlders and 1,740 c. y. of sand and gravel removed, **81**, 753. Cost of rock removed, $25.11 per c. y., **81**, 754.

**1881–82.** 1,886 c. y. rock, 834 c. y. bowlders, and 3,867 c. y. sand and gravel removed, **82**, 741.

**1882–83.** 1,481 c. y. rock, 643 c. y. bowlders, and 3,566 c. y. sand and gravel removed, **83**, 608.

**1883–84.** 288 c. y. of rock removed, **84**, 809.

At Cherry Island Flats:

**1879–80.** Commencement of operations; 300,000 c. y. dredged from channel, **80**, 579.

**1880–81.** 405,374 c. y. dredged from channel, **81**, 757.

**1881–82.** 409,342 c. y. dredged from channel, **82**, 743.

**1882–83.** 338,423 c. y. dredged from channel, **83**, 610.

**1883–84.** 141,601 c. y. dredged from channel, **84**, 810.

From Trenton, N. J., to the Mouth:

**1885–86.** Construction of gravel dike between Long Bar and Emily Islands, **86**, 803. Construction of 3,500 l. f. of brush and stone dike at Fisher's Point, **86**, 803. 91,194 c. y. dredged from channel across upper end of Five-Mile Bar, **86**, 805. 105,331 c. y. dredged from main ship channel west of Petty's Island, **86**, 805. 98,145 c. y. dredged from channel across Mifflin Bar, **86**, 806. Partial construction of 1,800 l. f. of dike at Mifflin Bar, **86**, 804. Survey and tidal observations in progress, **86**, 802.

**1886–87.** 33,806 c. y. dredged from channel across upper end of Five-Mile Bar, **87**, 789. 60,019 c. y. dredged from main ship channel west of Petty's Island, **87**, 789. Construction of 1,100 l. f. of revetment, and the removal, by dredging, of 58,125 c. y. in the formation of a channel across Smith's Island Bar, **87**, 790. Partial construction of 7,200 l. f. of dike at Mifflin Bar, **87**, 788. Commencement of dike from lower end of Reedy Island, **87**, 789. Survey between Bridesburg and Trenton, and tidal observations at points below Philadelphia in progress, **87**, 786, 787.

**1887–88.** 23,107 c. y. stone placed in Mifflin Bar Dike, **88**, 672. 20,000 c. y. dredged from the channel across Smiths Island Bar; 2,200 c. y. brush mattress and 18,300 c. y. stone placed in Reedy Island Dike, extending the same 2,000 f., **88**, 673, 674.

**1888–89.** 6,141 c. y. stone placed in Fishers Point Dike, **89**, 851. 1,000 l. f. of pile dike built at Fishers Point, **89**, 852. 52,471 c. y. dredged from main ship channel near Port Richmond, **89**, 852. 6,380 c. y. stone placed in Mifflin Bar dike, **89**, 854. 62,221 c. y. dredged from channel at Bulkhead Shoal; 3,673 c. y. of brush and 20,267 c. y. stone placed in Reedy Island dike; 250 c. y. rock removed at Schooner Ledge, **89**, 856, 857.

**1889–90.** 600 l. f. of pile and stone dike built at Kinkora Bar, **90**, 869. 10,773 c. y. stone placed in 3,500 l. f. of dike at Five Mile Bar, **90**, 870. 89,790 c. y. dredged from main ship channel at Port Richmond, **90**, 871. 1,178 c. y. rock removed from the channel near the foot of Otis street, Philadelphia; 20,452 c. y. brush mattress and 10,397 c. y. stone placed in Reedy Island Dike, **90**, 872, 874.

## DELAWARE RIVER, N. J. AND PA.—Continued.

**1890–91.** 600 l. f. of pile and stone dike and 200 l. f. of earthen embankment completed at Kinkora Bar, **91**, 1023. 1,300 l. f. of east dike completed at Bulkhead Bar, **91**, 1024.

**1891–92.** Dike completed and channel 175 f. wide and 12 f. deep dredged across Kinkora Bar; 1,300 l. f. of east dike and 1,350 l. f. of west dike built, and 51,810 c. y. dredged at Bulkhead Bar, **92**, 903.

**1892–93.** 669,630 c. y. dredged from Cherry Island Flats, **93**, 1145. 532 t. stone deposited in Bulkhead Bar dike and some repairs made, **93**, 1145.

**1893–94.** Repairs made to Mifflin Bar dike, **94**, 829. 290,832 c. y. dredged from Cherry Island Flats, **94**, 830. The dike at Bulkhead Bar strengthened and repaired, **94**, 831.

**1894–95.** 19,826 c. y. dredged from Perriwig Bar, **95**, 1024. Dike at Mifflin Bar repaired and raised to a height of 8 f. m. l. w., **95**, 1024. Bulkhead Bar dike strengthened and repaired, and 165,865 c. y. dredged from the channel in the vicinity, **95**, 1026. A portion of an old wreck removed from river near Ship John Light, **95**, 1027.

**1895–96.** 7,331 c. y. dredged from Perriwig Bar, dipper measurement, **96**, 883. 170 t. stone deposited in the repair of Mifflin Bar Dike, **96**, 884. 137,202 c. y. dredged from Bulkhead Bar, **96**, 884. 3,151 c. y. of mattresses and 6,682 t. stone placed in the dike at Reedy Island, **96**, 885.

**1896–97.** 169,235 c. y. dredged from Cherry Island Flats, **97**, 1193. 756,316 c. y. dredged from the vicinity of Dan Baker Shoal, **97**, 1193. Enlargement and repair of dike at Fort Mifflin in progress, **97**, 1193. In 1896 simultaneous tidal observations were taken at twenty-seven different stations between Delaware Breakwater and Trenton, N. J., **97**, 1192.

**1897–98.** 14,500 c. y. dredged from Perriwig Bar, **98**, 1076. 344,208 c. y. dredged from Cherry Island Flats, **98**, 1077. 3,069,334 c. y. dredged from the vicinity of Dan Baker Shoal, **98**, 1078. Enlargement and repair of dike at Fort Mifflin completed, **98**, 1078.

**1898–99.** 539,991 c. y. dredged from vicinity of Holly Oak Reach; 513,435 c. y., from Cherry Island Flats, and 129,127 c. y. from shoal below Christiana River, **99**, 1319. 253,581 c. y., dredged between Pennsville and Bulkhead Bar, 3,186,270 c. y., vicinity of Dan Baker Shoal and Bulkhead Bar dike repaired, **99**, 1320, 1321.

**1899–1900.** 832 c. y., s. m., rock removed from opposite Petty Island, **1900**, 1559; 2,500 l. f. of bulkhead partly constructed for the 30-foot channel improvement, **1900**, 1560.

**Physical characteristics.**

Between Trenton and Easton, **73**, 900, et seq.

Ice floods in the upper river, **73**, 904.

Rainfall, discharge of the river, velocity, etc., **73**, 905.

List of falls and rifts, **73**, 908.

Stages of water, **73**, 923.

Heights along the river, **73**, 923.

Bridges between Trenton and Easton, **73**, 925.

History of Scudders Falls, **73**, 929.

Proposed line of navigation from the Delaware River to the New York State line, **73**, 926.

Between Trenton and Bordentown, **71**, 81, 707.

Of Horseshoe Shoals, **71**, 705, 783; **79**, 423.

Of Schooner Ledge and Cherry Island Flats, **79**, 71, 433–436.

Of Mifflin Bar, **79**, 424, 425.

At Bulkhead Shoals, **79**, 427.

Of the river in general, **79**, 423; **98**, 1106; **1900**, 1619.

Ice harbors on the river, **79**, 424.

Average winter temperature, **72**, 784.

Law of increase of cross-sectional areas, **85**, 817, 819.

Current observations at eight cross sections between Fishers Point and Bombay Hook, **89**, 848.

Tidal observations between Bridesburg and Trenton, **90**, 878, 879.

Condition of the river channel between Philadelphia and Trenton, **90**, 880.

Causes that complicate the construction of a low-water channel of proper width and depth in the Delaware River, **95**, 1081.

Tidal observations, 1896, **97**, 1192.

**Plans.** (See *Estimates* and *Projects.*)

BETWEEN TRENTON AND EASTON:

By M. Merriam, improvement by wingdams, dredging, or scraping, and removal of rocks by drilling and blasting, at Ground Hog, Blackguard Island, and other places; estimate, $23,110.54, **73**, 921. Increased by Lt. Col. Kurtz to $25,922.33, **73**, 929.

FOR IMPROVEMENT AT HORSESHOE SHOALS:

By Lt. Col. Kurtz, for: (1) breaking up the ice by ice-boats and removing it; (2) for improvement of the waterway; (3) for unencumbered channels, **72**, 786. Discussion—the first requiring 3 ice-boats at an average yearly expense of $83,400, equivalent to a permanent sinking of $1,000,000, **72**, 78, 786. Estimated cost of the second plan, $1,062,788.62, **72**, 791; of the third plan, $1,300,000 to $1,700,000, **72**, 787, 788. The second plan recommended, **72**, 78. (See *Projects.*)

By Col. Weitzel, 1883, widening of the Pennsylvania channel opposite Pettys Island by the removal of a part of the

## DELAWARE RIVER, N. J. AND PA.—Continued.

west side of the island near its lower end, **84**, 795. In 1884 Maj. Heuer submitted a report and estimate for the proposed work of $1,010.460, **84**, 796.

Lt. Col. Robert, 1890, considers that any valuable and permanent improvement of the section of the river between Bordentown and Trenton would require the expenditure of a much larger sum than would be justified by existing commercial requirements, **90**, 882.

**Private (State, City, and corporate) work.**

BETWEEN TRENTON AND EASTON:

In 1771 the State of Pennsylvania appointed twenty-six commissioners to receive subscriptions for improving the river, and subsequently made appropriations for the same purpose as follows: 1817, $10,000; 1866, $10,000, **73**, 927. A large amount of money expended by the canal companies and private parties in building wing-dams and in removal of rock and other obstructions, **73**, 909, 915.

**1896–97.** 86,625 c. y. of rock and other materials were removed by the city of Philadelphia from Schooner Ledge, **97**, 1194.

**1897–98.** 28,615 c. y. of rock and other materials were removed from Schooner Ledge, and 1,017,780 c. y. were dredged from the channel in the vicinity of Mifflin Bar by the city of Philadelphia, **98**, 1078.

**1898–99.** 534,226 c. y. rock and other material removed from Greenwich Point, Mifflin Bar, and below Schooner Ledge by the city of Philadelphia, **99**, 1321.

**Projects.** (See *Estimates* and *Plans.*)

BETWEEN TRENTON AND EASTON:

By Lt. Col. Kurtz, improvement at various points. Estimate, $25,922.33, **73**, 929.

BETWEEN TRENTON AND BORDENTOWN:

By Lt. Col. Kurtz, cut 200 f. wide and 6 f. deep at low water at eastern end of Periwig Island and below Newbolds Island. Estimate, $75,000. Channel on west side of Periwig Island. Estimate, $65,000. The former recommended as the most advisable. **71**, 81, 707; **74**, ii, 142.

AT HORSESHOE SHOALS:

By Lt. Col. Kurtz, open ice-barriers, at a cost of $1,062,778, **72**, 78, 786, 788. Approved by Board of Engineers, **73**, 877; the improvement to be deferred until experience proved that ice-boats could keep the channel open, **74**, 92.

AT FORT MIFFLIN BAR:

By Lt. Col. Kurtz, a cut 1,500 f. in length and to 22 f. depth at low water. Estimate, $150,000. **73**, 872.

AT CHERRY ISLAND FLATS:

By Col. Macomb, improvement of the western channel by removing 1,520,000 c. y. by dredging. Estimate, $304,000. **79**, 438.

AT BULKHEAD SHOALS:

By Lt. Col. Kurtz, removal of 900,000 c. y., to straighten the channel at this point. Estimate, $275,000. **75**, ii, 192.

AT SCHOONER LEDGE:

By Capt. Ludlow, removal of rock to 24 f. depth. Estimate, $226,940. **79**, 435.

BETWEEN TRENTON AND BRIDESBURG:

The efforts of the past on this part of the river have been directed toward the improvement of the river between Trenton and Whitehill by dredging through the bar in the vicinity of Bordentown and Periwig shoal, so as to furnish navigable channels carrying 6 to 8 feet at m. l. w., **84**, 122; **85**, 115, 803; **86**, 113.

Plans for the comprehensive improvement of this part of the river not yet considered, **86**, 113.

BELOW BRIDESBURG:

By Col. Weitzel, 1884, formation of a dredged channel across Smiths Island Bar, just above the island, 350 f. wide and 10 f. deep at m. l. w., for the accommodation of the cross-river traffic, **84**, 124, 800; **85**, 805, 813, 814.

In 1885 Lt. Col. Robert proposed the formation of a channel 200 f. wide and 10 f. deep across Smiths Island Bar in the vicinity of that executed under the previous project. To provide as far as possible against the refilling of the channel it was proposed to give it protection by a line of revetment placed on each side of the dredged channel and also oblique to the axis of the bar, so as to direct into it a part of the ebb tide. Estimate, $40,000. **86**, 806, 826; **87**, 793, 794.

The projects prior to 1885 for the improvement of the river between Philadelphia and the bay have been directed toward the formation of channels 24 f. deep at m. l. w. across the bars below Philadelphia by means of dredging, except at Schooner Ledge, where solid rock was to be removed, **85**, 115, 804; **86**, 113.

The Board of Engineers of 1885 recommended the formation of a ship channel from a point opposite the upper end of Pettys Island to deep water in Delaware Bay, having a least width of 600 f. and a depth of 26 f. at m. l. w. The formation of such a channel to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works. Estimate, $2,425,000. **85**, 802, 822, 830. The project for the improvement

## DELAWARE RIVER, N. J. AND PA.—Continued.

of the river between Trenton and Philadelphia to be submitted after completion of detailed surveys, **85**, 799, 822; **86**, 113.

By Lt. Col. Robert, 1888, removal of 1,200 c. y. of ledge rock in the channel near the foot of Otis street, Philadelphia; estimate, $3,800, **90**, 871.

By Lt. Col. Robert, 1890, improvement of the river between Philadelphia and Trenton by the formation of a 12-f. low-water channel across Kinkora Bar by means of a pile and stone dike partly closing the slough south of Newbolds Island, supplemented by dredging on the line of the proposed channel; estimate, $15,000, **90**, 869.

By Maj. Raymond, 1890, improvement of Bulkhead Shoal by a modification of the project of 1885, whereby the improvement of the locality is to be accomplished by the construction of two pile and stone high-water dikes; the east dike, 4,200 f. in length, starting from the New Jersey shore and passing obliquely across the eastern ebb channel, and the west dike, 6,800 f. in length, situated upon the opposite side of the bar; estimated cost of both dikes, $280,000, **90**, 873, 874.

By Maj. Raymond, 1892, 26-f. channel 500 f. wide at Cherry Island Flats, by dredging; estimate, $100,000, **93**, 1145.

By Maj. Raymond, 1895, 6-f. channel 200 f. wide at Perriwig Bar, by dredging; estimate, $4,543.93, **95**, 1024.

By Maj. Raymond, 1894, 26-f. channel 600 f. wide in the vicinity of Bulkhead Bar, by dredging; estimated cost, $56,232; repairing the east dike, estimated cost, $13,300, and for repair of Mifflin Bar dike, estimate $1,000, **95**, 1025, 1026.

By Maj. Raymond, 1895, repair of Reedy Island dike, by depositing on it sufficient stone to raise it 1 f. above m. l. w., and for the construction of another portion of the projected dike, commencing at the Delaware shore and extending upstream for about 11,600 f.; total estimate, $120,000, **95**, 1027.

Act of June 3, 1896, required expenditure of $3,000 in rebuilding and enlarging dike on Government reservation at the junction of Schuylkill and Delaware rivers at Fort Mifflin, **96**, 884; **97**, 1193.

In 1896 the adopted project for the improvement of the river was modified on the recommendation of a Board of Engineers to provide for enlargement of channel from head of bay to deep water above Dan Baker Shoal, by dredging instead of by the action of dikes, **97**, 1193.

Act of June 3, 1896, required expenditure of $5,000 from appropriations for the river on Perriwig Bar. Maj. Raymond proposed, 1897, to widen the channel to 200 f. over the length of the bar, **98**, 1076.

By Lt. Col. Raymond, 1899, dredging and blasting a 30-f. channel, 600 f. wide from Christian street, Philadelphia, to deep water in Delaware Bay, along the axis of the main ship channel, and for rock removal at Petty Island; total estimate, $5,935,000, if completed within 6 years of commencement, **99**, 1321. Board of 1899 provided for construction of a bulkhead basin, Dan Baker Shoal, in which would be deposited dredged material from the 30-f. channel, forming an island that would probably help to maintain channel in that vicinity; estimate, according to Board, of 30-f. channel, $5,810,000 (map), **99**, 1321; **1900**, 1623.

By Lt. Col. Raymond, 1899, expenditure of $125,000, appropriated by act of March 3, 1899, for removal of rock near Petty Island, **99**, 1322.

By Lt. Col. Raymond, 1899, reservation of $18,400 from appropriation of June 3, 1896, for repair and maintenance of dikes, **1900**, 1561.

**Surveys.**

Between Trenton and Easton, in progress, **72**, 79. Report on, **73**, 899, 900. Cost of survey, $2,738.24, **73**, 900.

Between Trenton and Bordentown, ordered by act of July 11, 1870, in progress, **70**, 71. Report on, **71**, 707.

From Whitehill to above Bordentown, **79**, 70, 421.

Of Horseshoe Shoals, ordered by act of March 3, 1871, **71**, 81, 704; **72**, 77. Report on, **72**, 783.

Below League Island, ordered by act of June 18, 1878, **78**, 63; **79**, 75. Report on, **79**, 485.

Of Cherry Island Flats. Report on, **79**, 436.

At Schooner Ledge, 1842, by United States Coast Survey, **79**, 434. By Capt. William Ludlow, 1878. Report on, **79**, 434.

At Chester and Marcus Hook, **79**, 75. Sundry examinations, **79**, 70, 426, 427.

Ordered by act of June 14, 1880, **80**, 98; made under direction of Col. Macomb, **79**, 485; **81**, 743.

Between Trenton and Bordentown, **83**, 112.

In front of Philadelphia, **83**, 599; **84**, 799.

Above Bridesburg, **85**, 799; **86**, 802; **87**, 786.

Examinations of Five Mile Bar, in 1887 and 1888, to determine extent of dike's action in improving the bar, **88**, 670.

Survey of Reedy Island, made, 1887, under direction of Lt. Col. Robert, **88**, 674.

Examination of Kinkora Bar, made, 1889, under direction of Lt. Col. Robert, **89**, 849.

## DELAWARE RIVER, N. J. AND PA.—Continued.

Examination of Smith Island Bar, made, 1889, under direction of Lt. Col. Robert, **89**, 853.

Survey of Mifflin Bar, made, 1888, under direction of Lt. Col. Robert, **89**, 855.

Examinations of Smith Island Bar and Shoal, Greenwich Shoal, Mifflin Bar, and survey of Schooner Ledge, made, 1890, under direction of Maj. Raymond, **90**, 867, 868.

Minor surveys and examinations. (See reports for each year.)

Examination of the river between Trenton and Burlington, N. J., with a view to improving the river and protecting its banks ordered by act of August 17, 1894, made 1894, under direction of Maj. Raymond (report favorable from Burlington to Whitehill, and unfavorable thence to Trenton), **95**, 1080.

Survey with a view to obtaining a channel 30 feet deep ordered by act of June 3, 1896, made, 1898, under direction of Maj. Raymond. (See *Boards of Engineers*, report favorable). **98**, 1105.

Surveys of river in vicinity of Reedy and Pea Patch islands, made, 1899–1900, by order of Board of Engineers of 1899, **1900**, 1559.

MAPS.

Referred to. Survey of Horseshoe Shoals by David McClure, 1819, by city of Philadelphia, 1854–56 and 1864–66. **72**, 784.

Chart of Delaware near Bordentown, **79**, 422.

Of Fort Mifflin Bar, **79**, 426.

Of Bulkhead Shoals, **79**, 428.

Of Schooner Ledge, **79**, 434.

Of Cherry Island Flats, **79**, 436.

At Pettys Island, **80**, 564.

At Schooner Ledge, **80**, 578.

**88**, 670, 672, 682; **90**, 869, 870, 872; **92**. Atlas, 8; **1900**, 1618.

## DELAWARE RIVER TO CHESAPEAKE BAY (Canal). (See *Chesapeake* and *Delaware bays.*)

## DENNIS CREEK, N. J.

**Appropriation.**
1896, $5,000, **96**, 930.

**Commerce.**
Description of, **93**, 1188.

**Contract.**
**1897.** F. C. Somers, dredging, 11 cents per c. y. ($4,400), **97**, 1223.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 129; **95**, 133; **96**, 119; **97**, 151.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1892–97. Reports, **93**, 1187; **95**, 1105; **96**, 929; **97**, 1222.

ASSISTANT. F. Sylvester. Report, **95**, 1106.

**Physical characteristics.**
Description of, **93**, 1187; **95**, 1105.

**Operations.**
**1896–97.** 38,613 c. y. dredged and old wreck removed, **97**, 1222.

**Projects.**
By Maj. Raymond, 1895, dredging a channel 60 f. wide and 8 f. deep; estimate, $10,000, **95**, 930.

**Surveys.**
Examination ordered by act of July 13, 1892, made by Maj. Raymond, 1892 (report favorable), **93**, 1187.

Survey ordered by act of Aug. 17, 1894, made under the direction of Maj. Raymond, 1894 (see *Projects*), **95**, 1105.

## DESCHUTES RIVER. (See *Olympia Harbor, Wash.*)

## DES GLAISES BAYOU, LA. (See *De Glaise.*)

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 202; **91**, 230.

ENGINEER IN CHARGE. Capt. W. L. Fisk. Reports, **89**, 1512; **91**, 1854.

**Physical characteristics.**
Description of, **89**, 1512.

**Plans.**
In 1890, after examination for clearing the bayou of obstructions from the Atchafalaya River to Cottonfort, Capt. Fisk estimated the cost of such improvement at $2,500, **91**, 1855.

**Survey.**
Examination for slack-water navigation ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Fisk (report unfavorable) **89**, 1512.

MAPS. **89**, 1512.

## DES MOINES. (See *Mississippi River.*)

## DES MOINES AND IOWA RIVERS, IOWA.

**Appropriation.**[a]
1838, $1,000.

## DES MOINES RAPIDS (Canal). (See *Mississippi River.*)

## DES MOINES RIVER, IOWA.[b] (See *Iowa River, Iowa.*)

## DES PLAINES RIVER, ILL. (See *Illinois* and *Des Plaines rivers, Ill.*)

## DETROIT RIVER, MICH. (See also *Bridges, vol. 3, Detroit River, Grosse Point;* also *St. Clair Flats Canal.*)

**Appropriations.**

| | | |
|---|---|---|
| 1874, | $25,000, | **74**, 41. |
| 1878, | 100,000, | **78**, 125, 1223. |
| 1879, | 50,000, | **79**, 169, 1650. |
| 1880, | 50,000, | **80**, 2081. |
| 1881, | 50,000, | **81**, 2276. |
| 1882, | 60,000, | **82**, 2374. |
| 1884, | 200,000, | **84**, 2075. |
| 1886, | 37,500, | **86**, 1844. |
| 1888, | 130,500, | **88**, 1980. |
| 1892, | 30,000, | **92**, 2482. |
| 1894, | 30,000, | **95**, 3067. |
| 1896, | 30,000, | **96**, 2895. |
| 1899, | 100,000, | **99**, 3003. |
| 1900, | 200,000, | **1900**, 4003. |
| Total, | 1,093,000 | |

**Commerce.**

Large and increasing, **75**, 283.

The commerce of the entire chain of lakes benefited by this work, **75**, 284.

Benefits of the improvement to commerce, **88**, 1797.

In 1898 it was estimated that over 30,000,000 tons of freight used the river during the year, **98**, 2597.

Detailed description of, **99**, 3004.

**Contracts.**

**1876.** Case & Jennings, blasting and dredging, $7.50 per c. y., **77**, 735, 736.

**1878.** C. F. Dunbar, removing solid rock, $7 per c. y.; removing bowlders, $5 per c. y., **79**, 1651.

**1880.** C. F. Dunbar, rock removal, $7 and $1 per c. y., **81**, 2277.

**1881.** C. F. Dunbar, rock removal, $7 and $1 per c. y., **82**, 2374.

**1882.** C. F. Dunbar, rock removal, $7 and $1 per c. y., **83**, 1883.

**1884.** Carkin, Stickney & Cram, rock removal, $5.40 and $1 per c. y., **85**, 2168.

**1886.** Dunbar & Sullivan, rock removal, $6 and $1 per c. y., **87**, 2269.

**1888.** Dunbar & Sullivan, rock removal, **89**, 2272.

**1892.** C. E. Mitchell & Co., hire of dredge, tug, and 2 dump scows, $14.74 per hour, **93**, 3036.

**1894.** Carkin, Stickney & Cram, removing bowlders and other material, actual volume and s. m., 87 cents per c. y., **95**, 3068.

**1897.** M. Sullivan, removing bowlders, bed rock, etc., $4.15 per s. t., **97**, 3030.

**1900.** J. B. Donnelly, rock excavation, Limekiln Crossing, $2.27 per c. y. ($172,520). Buffalo Dredging Co., dredging, Ballards Reef channel, $2.65 per c. y. ($74,200). M. Sullivan, dredging, time work, Limekiln Crossing, $14.50 per hour. E. J. Hingston, dredging, time work, Ballards Reef, $10.25 per hour. **1900**, 4004.

**Engineers.**

CHIEF OF ENGINEERS:

Orders that the improvement shall be made wholly in American waters, **76**, ii, 546.

Reports, **74**, 47, 48; **75**, 52, 285, 286; **76**, 106, ii, 543; **77**, 111; **78**, 125; **79**, 168; **80**, 222; **81**, 303; **82**, 297; **83**, 305, 1885; **84**, 307; **85**, 331; **86**, 326; **87**, 93; **88**, 267; **89**, 317; **90**, 287; **91**, 361; **92**, 343; **93**, 393; **94**, 336, 367; **95**, 402; **96**, 356; **97**, 449; **98**, 437; **99**, 520; **1900**, 584, 587.

ENGINEERS IN CHARGE.

Majs. Comstock and Weitzel ordered to make estimate of cost, **74**, 48; joint report submitted, **74**, 213, 214. Report, Maj. Comstock, **75**, 283.

Maj. G. Weitzel, 1874–83. Reports, **75**, 281; **79**, 1650; 79, 1650; **80**, 2080; **81**, 2275; **82**, 2373. Correspondence, **76**, ii, 542–547; **77**, 935.

Capt. A. Mackenzie, in temporary charge, 1878. Report, **78**, 1223.

Maj. F. U. Farquhar, 1883. Report, **83**, 1885.

Lt. Col. O. M. Poe, 1883–95. Reports, **83**, 1882; **84**, 2074; **85**, 2165; **86**, 1842; **87**, 2266; **88**, 1978; **89**, 2272; **90**, 2745; **91**, 2793; **92**, 2481; **93**, 3034; **94**, 2376; **95**, 3066.

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[a] For survey, with a view to improving the river. (Treasury Doc. No. 373, 1882.)

[b] Surveys—Reports Oct. 9, 1841, estimate $29,000; Apr. 12, 1842. (H. Doc. No. 482, 55th Cong., 2d sess.).

## DETROIT RIVER, MICH.—Continued.

Lt. Col. G. J. Lydecker, 1896–. Reports, **96**, 2893; **97**, 3029; **98**, 2597, **99**, 3003, **1900**, 3997, 4015.

Assistants.

Capt. A. N. Lee, **75**, 282. Reports, **76**, ii, 545; **77**, 935.

H. A. Leavitt, **77**, 936. Report, **80**, 2080.

Capt. A. Mackenzie. Report, **79**, 1651.

Capt. B. D. Greene. Report, **80**, 2081.

H. Kallman. Reports, **81**, 2277; **82**, 2374; **83**, 1883; **84**, 2076; **85**, 2168.

B. H. Muehle. Report, **99**, 3004.

C. Y. Dixon. Report, **1900**, 4002.

**Estimates.** (See *Plans* and *Projects.*)

By Majs. Comstock and Weitzel, 1874, blasting and dredging channel at Limekiln, if partly in Canadian waters, $1,899,990; if wholly in American waters, 6 per cent additional; at mouth of river, $105,558, and 10 per cent for contingencies, **74**, 214.

By Maj. Comstock, for proposed improvements at Malden and mouth of Detroit River, $100,000, **75**, 283, 284.

By Maj. Weitzel, 1875, improvement at Limekiln Crossing for 18 f. channel, wholly in American waters, $500,000; if partly in Canadian waters, $262,000; for deepening shoal at mouth of river, $300,000; for a 20 f. channel additional, $900,000 to $1,000,000, **76**, ii, 544. Details, **76**, ii, 545. For completion of the work, channel 300 f. wide by 20 f. deep, $200,000, **77**, 936. Revised in 1879 to $250,000 to complete the work, **79**, 165, 168.

**Legislation.**

Resolution of the House of Representatives, directing estimate of cost to be made, Dec., 1873, **74**, 48. Proposed uniting of United States and Canadian Governments in this work, **75**, 52, 286.

**Operations.**

**1876–77.** 2,632 c. y. of rock removed by blasting and dredging, **77**, 935, 936.

**1879–80.** 90,000 s. y. drilled and blasted, 3,262 c. y. dredged, **79**, 168, 1652; 12,121 c. y. rock broken, 8,401 c. y. rock removed by dredging, **80**, 2082.

**1880–81.** 5,065 c. y. solid rock blasted, 10,775 c. y. rock dredged, **81**, 2277.

**1881–82.** 10,270 c. y. solid rock and 199 c. y. loose rock removed, **82**, 2374.

**1882–83.** 7,190 c. y. solid rock removed, **83**, 1884.

**1883–84.** 656 c. y. solid rock removed, **84**, 2076.

**1884–85.** 8,369 c. y. solid and 32 c. y. loose rock removed, **85**, 2166.

**1885–86.** 15,140 c. y. solid and 49 c. y. loose rock removed, **86**, 1843.

**1886–87.** 14,544 c. y. of solid and 144 c. y. of loose rock removed from the straight channel; total amount of work done on the improvement, **87**, 2267.

**1887–88.** 81,078 c. y. solid rock and 1,052 c. y. loose rock removed, **88**, 1979.

**1888–89.** 8,508 c. y. solid rock removed, **89**, 2272.

**1889–90.** 16,583 c. y. solid and 1,766 c. y. loose rock removed, **90**, 2745.

**1890–91.** 1,213 c. y. of solid and 1,554 c. y. loose rock removed from the channel, **91**, 2793.

**1894–95.** 2,230 c. y., s. m., large bowlders removed, **95**, 3067.

**1895–96.** 13,866 c. y., s. m., bowlders and other material removed, and a line of levels run from bench mark Trenton to Amherstburg, **96**, 2894.

**1896–97.** 5,174 c. y. dredged and 254 bowlders removed, **97**, 3029.

**1897–98.** About 10,000 tons bed rock and bowlders removed, **98**, 2597.

**1899–1900.** Rock excavating in progress at Limekiln Crossing; 780 bowlders removed from the channel below Limekiln Crossing, **1900**, 4001.

**Physical characteristics.**

Bed of river composed of rock. Swift current. **74**, 213, 214.

Water-level curves at Limekiln Crossing, Detroit River, **88**, 1979.

Description of, **1900**, 4016.

Water-gauge readings, **1900**, 4003.

**Plans.** (See *Estimates* and *Projects.*)

By Majs. Comstock and Weitzel, blasting and dredging a channel 300 f. wide by 20 f. deep at various places in the river between lakes Huron and Erie, **74**, 213, 214.

By Maj. Comstock, removing bowlders near Malden, dredging, buoying, and a light ship at the mouth of Detroit River, **75**, 283–285.

By Lt. Col. Poe, 1885, increasing width of channel to 400 f., at an additional cost of $167,986, **85**, 2166, 2167.

**Private (foreign) work.**

The Canadian Government removed 120 c. y. of rock, at a cost of $60 per c. y., **77**, 936.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Weitzel, 1876, improvement at Limekiln Crossing, expending, by contract, the available balance in blasting and dredging rock wholly in United States waters, **76**, 105, ii, 546. In 1878, for a channel 300 f. by 20 f., by drilling, blasting, and dredging, **78**, 1223; **79**, 1652. Estimate, $1,166,500, **80**, 222.

Modified, in 1883, by Maj. Farquhar to a straight channel of the same dimensions,

### DETROIT RIVER, MICH.—Continued.

at an additional cost of $40,000, **83**, 1885; **87**, 2268. Reduction cost of the work, **86**, 326; **87**, 2268.

In 1886 Col. Poe proposed increasing the width of the straight channel to 400 f., at an estimated cost of $168,000, **86**, 1843; **87**, 2268; **92**, 2481.

In 1895 Col. Poe estimated that it would cost $180,000 to dredge a channel from the head of Limekiln Crossing to the head of Ballards Reef, **95**, 3067.

Act of March 3, 1899, provided for continuing contract, not to cost more than $761,500 exclusive of the amount already appropriated, **99**, 3003.

Descriptions of plans submitted by Lt. Col. Lydecker, 1900, for 21-f. channel, **1900**, 4017. Adoption of any project apparently dependent upon a settlement of the question of lake-level regulation, **1900**, 4018.

**Surveys.**

By the Canadian Government and by Maj. Weitzel, 1875, **75**, 281–285.

Under direction of Maj. Weitzel, by H. A. Ulffers, 1875, **79**, 1652.

Examination of the American Channel ordered by act of September 19, 1890, made, 1890, under direction of Col. Poe, **91**, 2809.

Examination of the channel from Ballards Reef to the head of Limekiln Crossing made, 1892–94, by Col Poe, **93**, 3035, **94**, 2377, and an ice survey of the same locality made, 1896, by Lt. Col. Lydecker, **96**, 2894.

In 1896 a survey was made of the shoal abreast of Detroit, and in 1897 an ice survey from Limekiln Crossing to Bois Blanc Island, and for 1,680 f. over the east half of Ballards Reef, **97**, 3029.

Act of March 3, 1899, called for plans and estimates of cost of 21-f. channel from Detroit to Lake Erie, **99**, 3003; report by Lt. Col. Lydecker, 1900 (see *Projects*), **1900**, 4015.

Minor surveys, etc., **1900**, 4002.

MAPS:

Showing condition of the work June 30, 1877, **77**, 939; **80**, 2082; **81**, 2278; **82**, 2374; **83**, 1882; **84**, 2074; **85**, 2168.

Lime Kiln Crossing, **86**, 1843; **87**, 2267; **90**, 2746; **91**, 2794; **94**, 2376.

### DETROIT RIVER, MICH. (Channel at Grosse Pointe). (See *Detroit River.*)

**Appropriation.**

1888, $5,000, **89**, 2270.

**Commerce.**

Gross annual tonnage passing through Grosse Pointe Channel, **89**, 2268.

**Contract.**

**1889.** Dunbar & Sullivan, hire of one tug and two dump scows, $10 per hour, **90**, 2741.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **88**, 267; **89**, 315; **90**, 285, 289; **91**, 359; **92**, 342.

ENGINEER IN CHARGE. Lt. Col. O. M. Poe, 1883–92. Reports, **88**, 1978; (col.) **89**, 2267; **90**, 2740; **91**, 2790; **92**, 2478.

**Operations.**

**1889–90.** 2,500 c. y. material dredged, **90**, 2741.

**Plans.**

By Col. Poe, 1890, excavating a channel through the flats off Grosse Pointe, 800 f. wide and 20 f. deep, requiring the removal of 3,140,000 c. y., at a cost of $690,800; or for a channel 800 f. wide and 19 f. deep, the removal of 2,515,000 c. y., at a cost of $553,300, **90**, 2742.

**Projects.**

By Lt. Col. Poe, 1888, improvement of Grosse Pointe Channel, at the head of the Detroit River, by dredging to a depth of 19½ f. and a width of 800 f., involving the removal of about 2,515,000 c. y.; estimate, $553,300, **88**, 1978.

In 1891 Col. Poe proposed excavating a channel 800 f. wide, 5½ miles long, and 20 f. in depth, at a cost of $956,825, **91**, 2790; **92**, 2479.

**Survey.**

Ordered by act of August 11, 1888, made, 1890, under direction of Col. Poe, **90**, 2750.

### DEVILS LAKE, N. DAK. (See *Creel Bay.*)

### DIAMOND REEF. (See *East River.*)

## DICKINSON BAYOU, TEX.

**Commerce.**

Practically none; all products shipped by rail to local and northern markets, **1900**, 2400.

**Engineers.**

Chief of Engineers. Report, **1900**, 395.

Engineer in Charge. Capt. C. S. Riché, 1899–1900. Reports, **1900**, 2396, 2399.

Assistant. S. M. Wilcox. Report, **1900**, 2400.

**Physical characteristics.**

Dickinson Bayou or River empties into Galveston Lower Bay about 20 miles northwest from the city of Galveston, Tex., and is one of the adjacent streams referred to in the appropriation of Mar. 3, 1899, for improving "Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams," **1900**, 2397.

Description of, **1900**, 2397.

**Obstructions.**

The bayou is crossed by two Galveston County bridges, the Galveston, Houston and Henderson R. R., and the Galveston, Houston and Northern Rwy., the latter being the only one with a drawspan, **1900**, 2400.

**Projects.**

Capt. Riché estimated, 1900, it would cost $7,500 to make the improvement as a part of an inland light-draft navigation system, **1900**, 2399.

**Surveys.**

Examination and survey ordered by act of Mar. 3, 1899, made, 1899–1900, under direction of Capt. Riché (report favorable) (see *Projects*), **1900**, 2397, 2399.

## DISMAL SWAMP CANAL, N. C. AND VA.[a] (See *Cheasapeake Bay; Cheasapeake Bay to Charleston, S. C.*, and *Norfolk Harbor to Atlantic Ocean, etc.*

**Appropriations.**

| | | |
|---|---|---|
| 1826, | $150,000, | act May 18.[b] |
| 1829, | 50,000, | act Mar. 2.[b] |
| 1836, | 15,000, | act July 4. |
| 1838, | 10,000, | act Apr. 20. |
| 1845, | 5,000, | act Feb. 26.[b] |
| Total, | 230,000 | |

**Commerce.**

Important, **72**, 751.

Revenue from canal insignificant, **72**, 751.

Tolls during the war, **72**, 751.

Interest of the United States in the canal, **72**, 751.

**Engineers.**

Chief of Engineers. Report, **72**, 74.

Engineer in Charge. Maj. W. P. Craighill, **72**, 74. Report, **72**, 750.

Assistant. W. R. Hutton. Report, **72**, 750.

**Estimates.** (See *Plans.*)

**Physical characteristics.**

Description of, **72**, 750, 751; **76**, 392.

**Plans.**

By W. R. Hutton, to suppress two locks, leaving only one at each end; also for the enlargement of the canal and the lowering of the summit level; estimate, $480,000, **72**, 751.

**Surveys.**

Survey made, 1872, **72**, 74, 750.

(See survey for an interior water communication between Norfolk, Va., and the Atlantic Ocean, **79**, 74, 714; **76**, 392.)

## DISMAL SWAMP CANAL, WATERWAY CONNECTING WITH SOUNDS OF NORTH CAROLINA. (See *Dismal Swamp Canal, N. C. and Va.;* also, *Norfolk to Sounds of North Carolina.*)

**Appropriation.**

1894, $5,000, **95**, 1297.

**Commerce.**

In 1895 it was estimated that 695 craft of all kinds passed through the Dismal Swamp Canal, with an estimated tonnage of 16,000 tons, carrying merchandise amounting to 22,105 tons, and that 6,339 craft of all kinds passed through Albemarle and Chesapeake Canal in 1895, with an estimated tonnage of 458,602 tons, carrying merchandise amounting to 324,866 tons, **96**, 1092.

**Engineers.**

Chief of Engineers. Reports, **95**, 177; **96**, 159.

Engineer in Charge. Capt. T. L. Casey, 1894–96. Reports, **95**, 1296; **96**, 1086.

Assistant. F. W. Frost. Report, **96**, 1088.

**Physical characteristics.**

List of levels and locks of the Dismal Swamp Canal, and their sizes, **96**, 1088.

Water supply sufficient to maintain a canal 9 f. in depth.

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[a] Survey—Report, Aug. 2, 1826. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] H. Doc. 482, 56th Cong., 2d sess.

**DISMAL SWAMP CANAL, WATERWAY CONNECTING WITH SOUNDS OF NORTH CAROLINA**—Continued.

Table showing rainfall at Norfolk, Va., from 1885 to 1895, **96**, 1890.

Table of distances from Norfolk to Albemarle Sound via the canal, and list of connecting waters, **96**, 1093.

**Projects.**

By Capt. Casey, 1895, survey of the canal from Elizabeth River, Va., to Pamlico Sound, N. C., in such a manner as to give the necessary data for obtaining the cost of excavation for a 9-f. waterway, **95**, 1296.

Capt. Casey, 1896, estimated that the cost of constructing a 10-f. waterway would be $1,711,380, and a 9-f. waterway would cost $1,364,930. Attention called to the fact that the canal is the property of a private corporation. **96**, 1087.

**Survey.**

Survey of Dismal Swamp Canal and connections ordered by act of Aug. 17, 1894, made, 1895, by Capt. Casey, **96**, 1086. (See *Projects.*)

**DIVIDING CREEK, MD.**

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 151.

ENGINEERS IN CHARGE:

Lt. Col. W. P. Craighill. Report, **84**, 962.

Capt. T. Turtle. Report, **84**, 963.

ASSISTANT. J. L. Seager. Report, **84**, 963.

**Survey.**

Examination ordered by act of Aug. 2, 1882, made under the direction of Lt. Col. Craighill (report unfavorable) and Capt. Turtle, **84**, 962, 963.

**DIVIDING CREEK, N. J.**

**Commerce.**

Description of; important, **97**, 1242, 1244.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 154.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1896–97. Report, **97**, 1242.

**Physical characteristics.**

Description of, **97**, 1243.

**Surveys.**

Examination ordered by act of June 3, 1896, made by Maj. Raymond, 1896 (report favorable), **97**, 1243.

**DOBOY AND SAPELO, GA.**

**Commerce.**

Importance of the port of Darien, **92**, 1298.

**Engineers.**

CHIEF OF ENGINEERS. Report, **92**, 181.

ENGINEER IN CHARGE. Capt. O. M. Carter, 1890–92. Reports, **92**, 1294, 1295.

ASSISTANT. G. W. Brown. Report, **92**, 1299.

**Physical characteristics.**

Description of, **92**, 1296.

**Survey.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Capt. Carter (report unfavorable), **92**, 1295.

**DOBOY BAR, GA.** (See *Altamaha River.*)

**Appropriations.**

| | |
|---|---|
| 1886–87,[a] | $10,000. |
| 1899, | 70,000, **99**, 1574. |
| Total, | 80,000 |

**Commerce.**

Statistics of Darienport, **87**, 1182.

During 1898 about 143,000,000 f. of timber were carried on the river, **99**, 1573.

The bulk of the timber passing through Darien from the Altamaha River will probably cross Doboy Bar when the improvement is completed. When the timber is gone, which is a matter of comparatively few years, the commerce will probably greatly decrease. **1900**, 1934.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 150, 154; **88**, 141; **97**, 257; **99**, 260; **1900**, 297.

ENGINEERS IN CHARGE:

Col. Q. A. Gillmore, 1886–87. Reports, **87**, 1179, 1199.

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[a] From Altamaha River appropriation, **87**, 1179.

## DOBOY BAR, GA.—Continued.

Lt. O. M. Carter, 1888–97. Reports, **88**, 1041; (Capt.) **97**, 1538.

Capt. C. E. Gillette, 1899—. Reports, **99**, 1573; **1900**, 1933.

ASSISTANTS:

Lt. Carter. Report, **87**, 1181–1200.

G. W. Brown. Report, **97**, 1542.

**Operations.**

**1887–88.** Removal of Doboy Bar continued by harrowing and hydraulic excavation, **88**, 1042.

**1899–1900.** 47,229 c. y. dredged, **1900**, 1934.

**Physical characteristics.**

Description of, **87**, 1181–1200; **97**, 1542.

Material composing the bar easy to move by hydraulic dredge, **97**, 1539.

Tidal observations, **97**, 1542, 1544.

**Plans.**

Lt. Carter, 1888, did not consider the present or prospective demands of commerce sufficient to warrant further expenditure, **88**, 1044.

**Projects.**

By Col. Gillmore, 1887, formation of a channel over the bar by hydraulic excavation and propeller sluicing, **87**, 1181; **88**, 1041.

By Capt. Carter, 1887, dredging 24-f. channel, m. h. w., 300 f. wide across the bar; estimate, $70,000, **97**, 1541; **1900**, 1933.

**Surveys.**

Examination ordered by act of August 5, 1886, made 1886, under direction of Col. Gillmore, **87**, 1199.

Survey with a view to securing 24-f. depth at m. h. w., and to ascertain whether obstructions could be removed by dredging, ordered by act of June 3, 1896, made under the direction of Capt. Carter, 1897; report favorable, **97**, 1539 (see *Projects*).

Examination made, 1899, by Capt. Gillette, **99**, 1574.

MAPS. **88**, 1042; **99**, 1573.

## DOBOY TO SAPELO, GA. (inside route).

**Commerce.**

Important. Amply provided for by existing conditions. **92**, 1298.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 185; **92**, 181.

ENGINEER IN CHARGE. Lt. O. M. Carter, 1890–1892. Report, **92**, 1294.

ASSISTANT. G. W. Brown. Report, **92**, 1299.

**Physical characteristics.**

Description of, **92**, 1295; three possible routes, **92**, 1306.

Character of river bottom, **92**, 1302.

Progressing changes, **92**, 1303.

Currents, **92**, 1303.

**Surveys.**

Examination and survey ordered by act of Sept. 19, 1890, with a view to providing a channel for sea-going vessels, made by Lt. Carter, 1890 and 1891 (report unfavorable) (see *Commerce*), **92**, 1294.

## DODGES FALLS. (See *Connecticut River.*)

## DOG ISLAND HARBOR, FLA. (See *Carrabelle Bar* and *Harbor*, *Fla.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 189; **82**, 186.

ENGINEER IN CHARGE. Capt. A. N. Damrell. Report, **82**, 1314.

**Physical characteristics.**

Existing natural harbor needed no improvement, **82**, 1314.

**Survey.**

Ordered by act of Mar. 3, 1881, made under direction of Capt. Damrell, **82**, 1314.

## DOG RIVER, MISS. (See *Pascagoula River.*)

## DOLLAR POINT. (See *Galveston Bay ship channel.*)

## DONALDSONVILLE, LA., TO THE RIO GRANDE RIVER, TEX.

## (Canal.)

(See *Lafourche Bayou.*)

**Commerce.**

Important, **75**, 877, 880–883, 894.

**Engineers.**

Chief of Engineers. Reports, **73**, 66; **75**, 79; **79**, 112.

Engineer in Charge. Capt. C. W. Howell, 1873–75, **73**, 66; **75**, 79; **79**, 111. Report, **75**, 875.

Assistants:

J. A. Hayward. Report, **75**, 883.
H. C. Ripley, **75**, 889.
J. C. Polhemus. Reports, **75**, 895, 897.
Lt. H. M. Adams. Report, **75**, 893.

**Estimates.** (See *Plans.*)

By Capt. Howell, 1875, inland navigation from Donaldsonville to the Rio Grande: For section 1, channel from Donaldsonville to Vermillion Bay, $1,653,705; for section 2, Vermillion Bay to Sabine Lake, $1,587,889, and jetties at mouth of Sabine River, $90,828; Sabine Lake to Galveston Bay, $1,018,250; section 3, Galveston Bay to Brazos River, $212,144; section 4, lock at Rio Grande, $28,110; Indianola to Madre Lagoon, $3,258,288; Madre Lagoon to Rio Grande, $190,256, **75**, 880–883, 896–901; total, $8,039,461, **75**, 882.

**Physical characteristics.**

General description, **75**, 876–900.
High and low water range, **75**, 883.

**Plans.** (See *Estimates.*)

By Capt. Howell, 1875, inland navigation from Donaldsonville to the Rio Grande, as follows: Section 1, from Donaldsonville to Vermillion Bay by slack water via Bayou Lafourche to Napoleonville; thence by a canal in a direct line to Lake Verret; thence to Flat Lake; from Flat Lake via the Little Atchafalaya River and Bayou Teche to Franklin; thence to Cote Blanche Bay and via the latter and Vermillion Bay to Schooner Bayou; estimate, $1,653,705, **75**, 879, 880, 883, 884. Section 2, Vermillion Bay to Galveston Bay Canal; from Schooner Bayou to White Lake; thence via canal to Twin Lake, Alligator Lake, and Lake Callicon; thence via Bayou Callicon to Grand Lake, Bayou Lacassam to Lake Lacassam; Bayou Misère to Lake Misère; thence via canal to Will Lake; via Bayou Bois Connu to Calcasieu Lake; Kelsor Bayou to Black Lake (Sabine Lake); thence by small chain of lakes and Mud Bayou to East Bay Bayou (Galveston Bay); estimate, $2,696,967, **75**, 880–882, 889–896. Section 3, Galveston Bay to Brazos River by increasing the existing 3-f. navigation to 6 f. by cuts through reefs in West Galveston Bay and in Oyster Bay; thence through ridge separating Oyster Bay and Brazos River, to Brazos River; estimate, $212,144, **75**, 881, 898. Section 4, Brazos River to Rio Grande by canal from Brazos River across marshy prairies and through small fresh-water lakes to San Bernard River; thence through Cedar Lake; thence direct to Cany Creek; thence via Cany Creek to Matagorda Bay, and via the latter to Indianola Harbor. From Indianola to the Rio Grande a 6-f. tide-water canal, 80 f. wide at the top, following along the coast line, recommended as the only feasible plan; estimate, $3,476,644, **75**, 882. General discussion of routes: Section 1, lock projected in Bayou La Fourche impracticable, **75**, 878, 887. Dam and inclined plane impracticable, **75**, 879. Route via Bayou Teche with a cut to Bayou Cypre Mort, and dredging this bayou to Vermillion Bay, estimate, $1,258,538, not recommended, **75**, 880. Section 4, cuts through lagoons from Indianola Harbor to Rio Grande not permanent; estimate, $1,902,978, **75**, 882.

**Private (State and corporate) Work.**

A canal excavated by the Brazos Canal Company, connecting West Galveston Bay with the Brazos River, **75**, 898. A channel excavated by the State from Espiritu Santo Bay to San Antonio Bay and thence to Mesquite Bay, **75**, 898. Pass dredged between Aransas and Corpus Christi bays, **75**, 899.

**Surveys.**

By Capt. Howell, 1872, **73**, 66; **75**, 79, 876, 883, 889, 890, 893, 895, 897.
By Capt. Howell, 1879, **79**, 112.

## DORCHEAT BAYOU, LA. (See *Lake Bisteneau; Loggy Bayou.*)

**Engineers.**

Chief of Engineers. Report, **89**, 217.

Engineer in Charge: Capt. J. H. Willard. Report, **89**, 1630.

Assistant: H. M. Marshall. Report, **89**, 1630.

**Physical characteristics.**

Description of, **89**, 1630.

**Survey.**

Examination ordered by act of Aug. 11, 1881, made, 1889, under direction of Capt. Willard (report unfavorable), **89**, 1630.

### DORCHEAT RIVER. (See *Loggy Bayou, La.*)

### DOUBLE BAYOU, TEX. (See *Brazos River between Velasco and Richmond; West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams, Texas, and Trinity River, Tex.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 235; **98**, 287.

ENGINEERS IN CHARGE:

Maj. C. J. Allen. Report, **91**, 1933.

Maj. J. B. Quinn, 1898. Report, **98**, 1512.

Lt. C. S. Riché, 1898–. Report, **98**, 1512.

ASSISTANTS:

Lt. C. W. Langfitt. Report, **91**, 1935.

E. M. Hartrick. Report, **98**, 1514.

**Physical characteristics.**

Description of, **91**, 1935; **98**, 1513.

In 1898 the most recent survey had shown that nearly 2,200 f. intervened between 6-f. depth in Galveston Bay and the same depth in the bayou, **98**, 1513.

**Plan.**

In 1890 Maj. Allen did not consider the bayou worthy of improvement, **91**, 1934.

**Projects.**

In 1898 Lt. Riché estimated it would cost either $20,000 or $80,000, depending upon the plan adopted, to open a channel through the bar at the bayou mouth, **98**, 1514.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Allen, **91**, 1933.

Joint resolution of Mar. 5, 1898, called for submission of estimates for opening a channel through the bar at the mouth of the bayou. Report submitted, 1898, by Lt. Riché (see *Projects*). **98**, 1512.

### DOVER HARBOR, N. H. (See *Cocheco River.*)

### DRAKES BAY, CAL. (See *Pacific Coast, Harbor of Refuge.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **77**, 123.

BOARD OF ENGINEERS. For the Pacific coast, met Aug. 6, 1876, to examine certain harbors on the Pacific coast, with a view to establishing a harbor of refuge. The Board reported that when the commerce increases it may be necessary to build a harbor, **77**, 1051.

**Plans.**

By Board of Engineers for a breakwater 1 mile long, estimate $6,785,800, **77**, 1058.

### DREDGES AND SNAGBOATS.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1836, | $8,000.00, | Lake Erie. |
| 1841, | 4,369.00, | Lake Michigan. |
| 1852, | 100,000.00, | Lakes Champlain, Erie, Michigan, Ontario, and Chesapeake Bay, and Atlantic coast. |
| 1855, | $1,696.15, | Lakes Champlain Erie, Michigan, and Ontario. |
| 1855, | 8,617.81, | Relief. |
| 1866, | 550,000.00, | Western rivers. |
| 1881, | 50,000.00, | Shreves patent. |
| Total, | 722,682.96 | |

### DRUM INLET, N. C.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 170, 1425; **95**, 191.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1890. Report, **91**, 1425.

Maj. W. S. Stanton, 1892–95. Report, **95**, 1372.

ASSISTANT. Lt. M. M. Patrick. Report, **91**, 1427.

**Physical characteristics.**

Description of, **91**, 1426.

In 1895 they were exactly as described in report of 1890, an unbroken beach 3,000 to 4,000 f. across from ocean to sound, and 6½ f. above m. l. w., **95**, 1372.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made 1890, under direction of Capt. Bixby (report unfavorable), **91**, 1426.

Examination between Portsmouth and Cape Lookout ordered by act of Aug. 17, 1894, made by Maj. Stanton, 1895 (report unfavorable), **95**, 1372.

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[a] H. R. Doc. No. 482, 55th Cong., 2d sess.

## DUBUQUE HARBOR, IOWA. (See *Mississippi River from St. Paul to Des Moines Rapids.*)

## DUCK CREEK. (See *Smyrna River, Del.*)

## DUCK ISLAND HARBOR, CONN.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $25,000, | **91**, 758. |
| 1892, | 35,000, | **92**, 666. |
| 1894, | 30,000, | **95**, 776. |
| 1896, | 24,000, | **96**, 696. |

Total, 114,000

**Commerce.**

No local commerce, **84**, 684.

Necessity for harbor of refuge, **87**, 642.

**Contracts.**

**1891.** E. S. Belden, riprap breakwater construction, 94 cents per t., **92**, 759.

**1892.** S. & S. E. Belden, stone, 89 cents per t. ($26,700), **93**, 916.

**1894.** Hughes Bros. & Bangs, 38,255 t. stone, 68 cents per l. t., **95**, 777.

**1896.** J. F. Quinn, stone, 65 cents per gross t. ($16,250), **97**, 952. (Annulled—no stone delivered, **98**, 952.)

**1897.** J. Beattie, stone, 77 cents per gross t. ($19,250), **98**, 955.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 99; **87**, 56; **91**, 66; **92**, 70; **93**, 76; **94**, 67; **95**, 77; **96**, 75; **97**, 89; **98**, 94; **99**, 106; **1900**, 122.

ENGINEERS IN CHARGE:

Maj. J. W. Barlow. Report, **84**, 684.

Lt. Col. D. C. Houston, 1887–92. Reports, **87**, 641; (Col.), **91**, 757; **92**, 664.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 914; **94**, 638; (Col.), **95**, 774.

Maj. H. M. Adams, 1896. Report, **96**, 694.

Maj. S. S. Leach, 1897–. Reports, **97**, 951; **98**, 953; **99**, 1161; **1900**, 1331.

**Operations.**

**1890–91.** 5,126 t. riprap placed in breakwater, completing 270 l. f. of work, **91**, 758.

**1891–92.** 18,336 t. riprap placed in breakwater, completing 676 l. f., **92**, 665.

**1892–93.** 8,087 t. stone placed in breakwater, **93**, 915.

**1893–94.** 25,925 t. stone deposited, **94**, 639.

**1895–96.** 39,414 t. deposited, **96**, 695.

**1897–98.** 20,935 t. deposited, **98**, 953.

**1898–99.** About 4,000 t. deposited, **99**, 1161.

**Physical characteristics.**

Description of, **91**, 757.

**Projects.**

By Maj. Barlow, 1882, formation of a small harbor of refuge by the construction of a breakwater from 1,200 to 1,800 y. in length, estimate $200,000, **87**, 648.

Modified and enlarged by Lt. Col. Houston, 1886, providing for the construction of three breakwaters of riprap, one extending westerly from Duck Island, 3,000 f. long; one extending northeast from Duck Island, 1,750 f. long, and the third extending southwesterly from Menunketesuck Point, 1,130 f. long. These breakwaters to be of 10 f. width at the top, to extend to 6 f. above high water, and to inclose an area of about 115 acres; estimate $463,540, **87**, 642; **91**, 757.

**Surveys.**

Examination ordered by acts of Aug. 2, 1882, and Aug. 5, 1886, made under direction of Maj. Barlow, **84**, 684, and under direction of Lt. Col. Houston (see *Projects*), **87**, 641.

## DUCK RIVER, TENN.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $7,000, | **80**, 1681. |
| 1881, | 3,000, | **81**, 1868. |
| 1882, | 3,000, | **82**, 1852. |

Total, 13,000

**Commerce.**

Requirements of, fairly provided for by improvement made, **86**, 1523.

Description of: small, but the river runs through a rich country, which improvement of the channel might develop, **93**, 2407.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 187, 190; **81**, 253; **82**, 247; **83**, 255; **84**, 255; **85**, 277; **86**, 269; **87**, 233; **88**, 210; **93**, 307; **97**, 424.

ENGINEERS IN CHARGE:

Maj. W. R. King, 1879–86. Reports, **80**, 1681; **81**, 1867; **82**, 1851; **83**, 1497; **84**, 1651; **85**, 1768.

Lt. Col. J. W. Barlow, 1886–88. Reports, **86**, 1523; **87**, 1757; **88**, 1610.

Lt. Col. H. M. Robert, 1893. Report, **93**, 2406.

## DUCK RIVER, TENN.—Continued.

Capt. J. Biddle, 1893. Report, **93**, 2406.

Assistants:
D. L. Sublett. Report, **80**, 1682.
Lt. J. Biddle. Report, **93**, 2407.

**Operations.**

**1880–81.** Boats built, and 55 snags and 1,281 trees removed by hired labor, **81**, 1868.

**1881–82.** 1,005 snags and trees cut out, 659 c. y. excavated from channel, and 537 c. y. rock quarried and placed in dams, **82**, 1852.

**1882–83.** 53 c. y. of rock, 567 of gravel, and 1,637 of earth excavated from channel, 755 c. y. stone quarried and placed in dams, and 1,174 trees and snags removed, **83**, 1498.

**Physical characteristics.**

Condition of river, character of obstructions, etc., **80**, 1683.

Description of: Flows into the Tennessee; navigable for about 68½ miles. **93**, 2406.

**Projects.**

By Maj. King, 1879, improving river, its mouth to Centerville, 68 miles, by rock and gravel excavation, construction of wing-dams and removal of snags and overhanging trees, to give 3-f. navigation during six months of the year. Estimate. $35,118, **80**, 1684.

**Surveys.**

Ordered by act of Mar. 3, 1879; made 1880, under direction of Maj. King, **79**, 142; **80**, 1681.

Examination ordered by act of July 13, 1892; made 1892, under the direction of Lt. Col. Robert (report favorable), **93**, 2406.

## DUGDEMONA RIVER OR BAYOU, LA.

**Commerce.**

Description of: unimportant, **95**, 1961, 1962.

**Engineers.**

Chief of Engineers. Reports, **87**, 203; **95**, 279.

Engineer in Charge. Capt. J. H. Willard, 1887–95. Reports, **87**, 1489; **95**, 1961.

**Physical characteristics.**

Description of: a tortuous creek uniting with Bayou Castor to form Little River, **95**, 1962.

**Plans.**

Capt. Willard, 1887, reported that any improvement would be unadvisable and not a public necessity, **87**, 1489.

**Surveys.**

Examination ordered by act of Aug. 5, 1886; made, 1887, under direction of Capt. Willard (See *Plans*), **87**, 1489.

Examination ordered by act of Aug. 17, 1894; report made by Capt. Willard, 1895 (report unfavorable), **95**, 1961.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS. (See *Great Lakes; Nemadji River, Wis.*)

| Part. | Appropriation. |
|---|---|
| A.—Superior City Harbor | $315,305.64 |
| B.—Superior Bay | 22,628.16 |
| C.—Superior Bay and St. Louis Bay, Wis | 377,500.00 |
| D.—Duluth Harbor | 3,183,124.70 |
| E.—Minnesota Point, Superior Bay, Wis | 4,895.00 |
| F.—Allouez Bay | |
| Total | 3,903,453.50 |

### Part A.—Superior City Harbor, Wis., natural entrance to Bay of Superior.

**Appropriations.**[a]

1867, $63,000.00, **67**, 20; **68**, 26.
1869, [b] 44,550.00, **69**, 22 (allotted).
1870, 40,000.00, **70**, 33.
1871, 60,000.00, **71**, 30.
1872, 50,000.00, **72**, 30.
1873, [c] 41,322.64
1875, [d] $5,433.00, **75**, 40 (allotted).
1876, 3,000.00, **76**, 36, 93 (allotted).
1878, 3,000.00, **78**, 112, 1128.
1879, 5,000.00, **79**, 150.

Total, 315,305.64

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[a] Remarks on want of consistency and uniformity in making appropriations, **68**, 79.
[b] Called $45,000, **70**, 127; **74**, 132.
[c] Called $63,950.80, **74**, 132 (allotted from appropriation of 1873 for Superior Bay).
[d] Allotted from appropriation for repair of harbors on northern lakes.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part A.—Superior City Harbor, Wis., etc.—Continued.

**Commerce.**

Commercial importance as a future railroad center, 67, 60; 68, 81; 73, 128.

Commerce requires depth of 16 f. at m. l. w., 67, 252.

**Contracts.**

**1867.** R. G. Coburn, timber, 67, 62.

**1867–68.** P. White, iron bolts and spikes. Coburn & Ray, framing. D. Smoke, materials. 67, 57, 62; 68, 83.

**1869.** R. G. Coburn, materials and labor, 69, 72.

**1874.** Proposals for stone, $5.15 to $13.95 per cord, 74, 134.

**1876.** H. M. Peyton & Co., brushwork, 76, ii, 319.

**Engineers.**

CHIEF OF ENGINEERS. Reports, 66, iii, 9; 67, 20, 252; 68, 26; 69, 23; 70, 33, 127; 71, 30; 72, 29; 73, 30; 74, 35; 75, 40; 76, 93; 77, 97; 78, 112; 79, 150.

BOARD OF ENGINEERS. Convened at Chicago, Ill., Apr. 16, 1873, to consider and report on best mode of applying appropriation of Mar. 3, 1873. Recommended (1) completion of piers at both Superior entrance and Duluth Canal, with dredging at both entrances; (2) dredging channel in Superior Bay from the natural entrance to the docks of Superior City and Duluth. Report, 73, 129. (Col. Macomb, Lt. Col. Tower, and Majs. Weitzel, Houston, and Farquhar.)

ENGINEERS IN CHARGE:

Maj. W. F. Raynolds, 1866–67, 66, iii, 8. Reports, 66, iv, 87; 67, 256.

Maj. J. B. Wheeler, 1867–70. Reports, 67, 55; 68, 79; 69, 71.

Maj. D. C. Houston, 1870–73. Reports, 70, 89; 71, 108; 72, 111.

Maj. F. U. Farquhar, 1873–78. Reports, 73, 128, 131; 74, 132; 75, 183; 76, ii, 319; 77, 837; 78, 1128.

Capt. C. J. Allen, 1878–79. Report, 79, 1468.

ASSISTANTS:

H. Bacon. Reports, 67, 60; 68, 80; 69, 71.

E. C. Clark, 68, 82.

J. B. Schrom, 68, 82.

Capt. J. W. Cuyler, 69, 23, 71.

Capt. A. M. Miller. Report, 72, 111.

J. P. Frizell. Report (historical sketch of the work), 79, 1470.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Raynolds, two pile piers 5,000 f., $178,000, 66, iii, 10, iv, 89; with 2,000 f. single row of piling, $145,500, 66, iv, 89; 200 f. longer on each pier, $25,000, 67, 256.

By H. Bacon, 4,300 f. crib piers 20 f. wide, with 42,000 c. y. dredging, $309,716, 67, 62; for cut through Minnesota Point (110,000 c. y. dredging) and 3,000 f. crib piers 20 f. wide, $252,780, 67, 62; for crib piers, one to 18 f. water, and stone protection to beach at Minnesota Point, $263,300, 68, 26, 84. Estimates diminished, with reasons therefor, 68, 83.

By Maj. Wheeler, completion of the work, 1869; extension of piers, $155,300, 69, 73; 70, 90.

By Maj. Houston, additional, $10,000, 72, 111.

**Operations.**

Historical sketch of operations, 79, 1470.

**1867–68.** 768 l. f. north pier, Minn., built; 374½ cords of stone deposited at Minnesota Point as embankment to close outlet, 67, 61; 74, 132; 68, 812; 69, 23.

**1868–69.** 320 l. f. north pier, Minn., built; 32 l. f. south pier, Wis., built; 178 f. wing-dam built, 69, 23; 70, 127.

**1869–70.** 32 l. f. north pier, Minn., built; 608 l. f. south pier, Wis., built, 70, 89.

**1870–71.** 768 l. f. north pier, Minn., built; 96 l. f. south pier, Wis., built, 71, 30; 79, 1473.

**1871–72.** 768 l. f. north pier, Minn., built; 1,184 l. f. south pier, Wis., built; scraping in channel (10 f. depth gained), 72, 30, 111.

**1872–73.** 200 l. f. north pier, Minn., built; [a] 792 l. f. south pier, Wis., built; scraping (12 f. depth gained), 73, 30, 131.

**1874–75.** No operations (12½ f. depth gained), 75, 183.

**1875–76.** 300 l. f. north pier, Minn., built; 720 f. brush protection of beach (12 f. depth gained), 76, 93, ii, 319.

**1876–77.** Repairs to north pier, 77, 97.

**1877–78.** A brush and stone protection built at the "opening" on Minnesota Point, and repairs to outer cribs, 78, 112, 1128.

**1878–79.** 3,000 willows set out on beach; dredging (10 f. depth gained), 79 1468.

**Physical characteristics.**

Of west end of Lake Superior, 71, 1471.

Of Superior Bay and channel at the mouth of the St. Louis River, 66, iii, 9, iv, 88; 67, 60.

Ice in bay, 68, 82.

**Plan.** (See *Estimates*.)

By H. Bacon, for cut across Minnesota Point 200 f. wide, with cribbed sides, 67, 61.

[a] 642 feet+150 feet.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part A.—Superior City Harbor, Wis., etc.—Continued.

**Project.** (See *Estimates.*)

By Maj. Raynolds, to close entrance to St. Louis River from 800 to 300 f. by two piers, on the south 2,000 f., on the north 3,000 f., to 12 f. water, without dredging (which would benefit interested parties); cost, $178,000, **66**, iii, 10, iv, 89. If to 16 f. water, $50,000 additional, **67**, 252; to 14 f. water. $25,000, **67**, 256. As adopted, included protection to beach on Minnesota Point by enrockment of rubble stone; crib piers 3,904 l. f., 1 to 18 f. water; cost, $263,300, **68**, 26, 81.

**Surveys.**

Made by United States Lake Survey in Aug., 1866, **66**, iv, 88; **67**, 559.

Made from ice in 1869–70, **70**, 89.

Special survey by Maj. Houston and W. H. Newton, C. E., **73**, 137 et seq. (See *Superior Bay.*)

### Part B.—Superior Bay, Wis. (See *Duluth Harbor* and *Superior City Harbor.*)

**Appropriation.**

1873, $100,000, **73**, 30; (but $22,628.16 expended, **74**, 132).

**Contract.**

Dodge & Moses, 1873, dredging, 18½ and 28 cents per c. y., **73**, 131, 132.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 30; **74**, 35. Decision on report of Board of Engineers, **73**, 130. Report to Secretary of War on survey by Maj. Houston and W. H. Newton, C. E., **73**,137.

BOARD OF ENGINEERS. Convened at Chicago, Ill., April 16, 1873. Recommended a certain order for expenditure of the $100,000 appropriated, **79**, 1474. Report, **73**, 129. Decision of Chief of Engineers, **73**, 130. (Col. Macomb, Lt.-Col. Tower, and Majs. Weitzel, Houston, and Farquhar.)

ENGINEERS IN CHARGE:

Maj. D. C. Houston, 1873. Report, **73**, 141, 148.

Maj. F. U. Farquhar, 1873. Report, **73**, 128, 132.

ASSISTANTS:

J. Pierpont, 1873 (special survey). Report, **73**, 162.

J. P. Frizell. Report (historical sketch of the work), **79**, 1470.

**Estimates.** (See *Projects.*)

Maj. Farquhar, repairs of dike, $55,000, **73**, 132; $87,199, **74**, 133. Dredging, $100,000 in addition to $100,000 appropriated, **73**, 132.

**Operations.** (See also *Survey.*)

Historical sketch, **79**, 1470.

**1873–74.** Dredging commenced in channel from deep water to Quebec wharf. An opening was made in dike and two protection cribs placed therein, **73**, 132; **74**, 132.

**Physical characteristics.**

Mean water level of Superior Bay, **73**, 140.

Physical geography of west end of Lake Superior, **73**, 141; **79**, 1471.

**Project.**

By Board of Engineers, channel 200 f. wide and 13 f. deep, from the existing channel in Superior Bay to Quebec wharf, Superior City, an opening to be made through the dike, **73**, 130.

**Secretary of War.**

Letter to, from Gov. C. C. Washburn, of Wisconsin, appointing W. H. Newton, of Minneapolis, Minn., as engineer on part of State of Wisconsin to make special survey of Superior Bay, etc., **73**, 149.

**Surveys.**

Observations made on currents and water levels, **72**, 106.

Special survey by Maj. Houston and W. H. Newton, C. E., at request of governor of Wisconsin, **73**, 137, *et seq.*; **79**, 1474. Mr. Newton's criticism of Maj. Comstock's tide-gauge record. Letter from Maj. Comstock, **73**, 139. Maj. Houston's report, **73**, 141, 148. J. Pierpont's report, **73**, 162. Report of W. H. Newton, C. E., to Secretary of War, **73**, 173.

Survey ordered by act of March 3, 1879, to determine the best and most economical plan for harbor improvement for the head of Lake Superior, **79**, 136, 1469.

MAPS. List of maps accompanying reports on the special survey, **73**, 155.

### Part C.—Superior Bay and St. Louis Bay, Wis. (See *Duluth Harbor, Minn.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $5,000, | **80**, | 1882. |
| 1881, | 10,000, | **81**, | 2025. |
| 1882, | 40,000, | **82**, | 2105. |
| 1884, | 45,000, | **84**, | 1820. |
| 1886, | 22,500, | **86**, | 1636. |
| 1888, | 50,000, | **88**, | 1811. |

**Appropriations**—Continued.

| | | | |
|---|---|---|---|
| 1890, | $65,000, | **90**, | 2294. |
| 1892, | 70,000, | **92**, | 2136. |
| 1894, | 50,000, | **95**, | 2552. |
| 1896, | 20,000, | **96**, | 2349. |
| Total, | 377,500 | | |

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part C.—Superior Bay and St. Louis Bay, Wis.—Continued.

**Commerce.**

Large harborage of bay, **80**, 1886.

Decline of commerce up to 1880, **81**, 269.

Necessity in 1881 for increased harborage, **81**, 2027.

Increase of commerce, **83**, 1623; **87**, 1950.

Channels in Superior Bay should be deepened to correspond with increased demands of vessels, **85**, 1859, 1964; **86**, 1635.

In 1895 it amounted to $47,304,140 per annum, **96**, 2348.

**Contracts.**

**1881.** Williams & Upham, dredging, 18 and 20 cents per c. y., **82**, 2105.

**1882.** Williams & Upham, dredging, 17 cents per c. y., **83**, 1621.

**1884.** Williams & Upham, dredging, 24 cents per c. y., **84**, 1818; 15 cents per c. y., **85**, 1947.

**1886.** C. S. Barker, dredging, 18 cents per c. y., **87**, 1949.

**1888.** C. S. Barker, dredging, 14½ cents per c. y., **89**, 2013..

**1891.** C. S. Barker, dredging, 14 cents pur c. y., **91**, 2498.

**1892.** C. S. Barker, dredging, 14½ cents per c. y., **93**, 2672.

**1893.** E. McCue, pier repairs, $4,589.80, **94**, 2022.

**1894.** C. S. Barker, dredging, 12½ cents per c. y. R. B. Dear, pier repairs; timber, $15.50 per 1,000 f., b. m.; rock, $6 per cord, **95**, 2553.

**1895.** F. L. McDonald, pier repairs, $5,167, **95**, 2553.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 201; **81**, 269; **82**, 264; **83**, 273; **84**, 272; **85**, 294, 296; **86**, 288; **87**, 254; **88**, 230; **89**, 270; **90**, 243; **91**, 312; **92**, 298; **93**, 338; **94**, 310; **95**, 346; **96**, 303.

BOARD OF ENGINEERS. Convened by S. O., No. 3, C. of E., 1881. (Maj. Houston and Capts. McKenzie and Allen), Reports, **80**, 2024, 2029. (See *Projects*.)

ENGINEERS IN CHARGE:

Maj. F. U. Farquhar, 1879. Report, **79**, 1468.

Maj. C. J. Allen, 1879–86. Reports, **80**, 1880; **81**, 2024; **82**, 2103; **83**, 1618; **84**, 1818; **85**, 1944, 1959; **86**, 1632.

Capt. J. B. Quinn, 1886–91. Reports, **87**, 1945; (Maj.), **88**, 1809; **89**, 2010; **90**, 2291.

Capt. W. L. Fisk, 1891–92. Reports, **91**, 2495; **92**, 2132.

Maj. C. B. Sears, 1893–96. Reports, **93**, 2668; **94**, 2019; **95**, 2549; **96**, 2346.

ASSISTANTS:

J. P. Frizell. Report, **80**, 1889.

G. Wells. Report, **83**, 1621.

J. B. Parkinson. Report, **85**, 1963.

**Legal proceedings.**

Title to the land occupied by the southerly pier not vested in the United States, and the necessary steps to secure the title recommended, **93**, 2668; **94**, 2019; **95**, 2550; **96**, 2347.

**Operations.**[a]

**1879–80.** Dredging at Rices and Connors points. Repairs to piers at entry and the preservation of Minnesota and Wisconsin points, by hired labor. **80**, 201, 1880.

**1880–81.** Repairs, by hired labor, to piers and shore protection at Minnesota Point, **81**, 2024.

**1881–82.** Repairs to piers at entry and dredging 53,466 c. y. from the entry Nemadji River and Quebec wharf channels, **82**, 2103.

**1882–83.** Protection of Minnesota Point Beach, by hired labor, 103,629 c. y. dredged from channels at the entry, Quebec wharf, and Northern Pacific R. R. dock, **83**, 1619.

**1883–84.** Repairs by hired labor, to Minnesota Point shore protection; 90,674 c. y. dredged from channels at entry, Quebec wharf, and Northern Pacific R. R. dock, **84**, 1818.

**1884–85.** Extensive repairs, by hired labor, to 867 l. f. of the south pier, with slight repairs to north pier and sand fence at the opening; 152,788 c. y. dredged from channels at the entry, Quebec wharf, and Northern Pacific R. R. dock, **85**, 1944.

**1885–86.** Repairs to piers at entry, by hired labor; 34,485 c. y. dredged from channels at entry, in St. Louis River, and at Quebec and Northern Pacific R. R. docks, **86**, 1634. Ruling depths of channels dredged, **86**, 1634.

**1886–87.** Deepening channel along Wisconsin dock line, St. Louis Bay, **87**, 1947.

**1887–88.** 32,473 c. y. dredged from channels and dock area, **88**, 1810.

**1888–89.** 75,700 c. y. dredged, **89**, 2011.

**1889–90.** 84,286 c. y. dredged, **90**, 2292.

**1890–91.** 110,375 c. y. dredged, **91**, 2496.

**1891–92.** 165,875 c. y. dredged, **92**, 2134.

**1892–94.** 68,966 c. y. dredged and piers strengthened, **93**, 2670; **94**, 2019.

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[a] History of previous operations, **79**, 1470; **86**, 288, 1632.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part C.—Superior Bay and St. Louis Bay, Wis.—Continued.

**1894-95.** North and south piers repaired, and dredging in progress, **95**, 2551.

**1895-96.** Dredging of preceding year completed, **96**, 2347.

**Physical characteristics.**

Changes at head of bay, **80**, 1885, 1889.

Movement of drift, **80**, 1886.

Time of opening and closing bay in winter, **80**, 1889.

Oscillation of lake surface, **80**, 1891.

Description of St. Louis Bay and River, **85**, 1963.

Description of, **88**, 1809; **89**, 2010.

Shoaling on the Wisconsin side, **93**, 2668; **94**, 2019; **95**, 2551; **96**, 2347.

**Plans.**

By Maj. Allen, 1885, for improvement of St. Louis Bay by dredging a channel 250 f. wide and 16 f. deep on the Wisconsin side past Connors Point to 1,000 f. along the railroad bridge. Estimate, $70,950. **85**, 1959, 1963; **87**, 1947.

**Projects.**

By Board of Engineers, 1881, enlargement of harbor area and channel facilities by deepening to 16 f. the channel in entry between the piers, and from thence parallel to shore of Superior Bay, past the mouth of Nemadji River, to Quebec wharf, thence along west side of bay to an intersection with the channel of the St. Louis River opposite Connors Point; also the deepening of Nemadji River for about half a mile; estimated cost of dredging, $287,080; the preservation of existing piers by repairs at an estimated cost of $25,000. Estimated cost of entire project, $312,080, **81**, 270, 2024, 2028; **82**, 2103.

In 1884 Congress provided for deepening to 16 f. the channel of the St. Louis River within Superior Bay, thereby adding $33,000 to the original estimate for existing project, **85**, 294, 1962; **86**, 1633; **87**, 1948.

In 1888 the estimated cost of $345,080 was increased by $114,156, for completion of the channel along the Wisconsin dock line in St. Louis Bay, making the total required for completion of the extended project, in 1888, $341,736, **88**, 1810, 1811.

By Maj. Sears, 1892-93, expending the appropriation of 1892, $70,000, as follows: Pier repairs; dredging entry and widening channel at narrow points up to and through the Quebec channel; for a new channel from Quebec dock along the west side of Superior Bay; for widening channel in St. Louis Bay; for extending channel in St. Louis Bay westward along the West Superior dock line, **93**, 2669.

By Maj. Sears, expending $30,000 of the appropriation of 1894 in extending the Superior dock line channel, and $15,000 in dredging along the Wisconsin dock line, **95**, 2551.

Congress by act of 1896 authorized the deepening of all the channels to depth of 20 f. with corresponding widths, the dredging of turning-basins at the junctions of the channels, and the renewal of the entrance piers, **96**, 2347.

**Surveys.**

Under direction of Capt. Allen, 1880, to determine the best plan for harbor improvement for the head of Lake Superior, **80**, 1884, 1889.

Survey of St. Louis Bay and River from Connors and Rices points to foot of first falls, ordered by act of July 5, 1884, made under direction of Maj. Allen, **85**, 1959.

MAPS. **85**, 1944; **87**, 1944; **90**, 2292.

### Part D.—Duluth Harbor, Minn. (See also Parts A, B, and C.)

**Appropriations.**

| | | |
|---|---|---|
| 1871, | $60,000.00, | **71**, 30. |
| 1872, | 50,000.00, | **72**, 29. |
| 1873, | [a]36,049.20, | **71**, 838; **73**, 131. |
| 1874, | 10,000.00, | **74**, 132. |
| 1875, | 35,000.00, | **75**, 40. |
| 1876, | 15,000.00, | **76**, 93. |
| 1878, | 30,000.00, | **78**, 111, 1127. |
| 1879, | 25,000.00, | **79**, 150. |
| 1880, | 25,000.00, | **80**, 1876. |
| 1881, | 40,000.00, | **81**, 2022. |
| 1882, | 45,000.00, | **82**, 2098. |
| 1884, | 45,000.00, | **84**, 1813. |
| 1886, | 56,250.00, | **86**, 1631. |
| 1888, | 80,000.00, | **88**, 1807. |
| 1890, | 100,000.00, | **90**, 2288. |
| 1892, | 125,000.00, | **92**, 2130. |
| 1894, | $75,000.00, | **95**, 2538. |
| 1896, | 30,000.00, | **96**, 2343. |
| 1897, | 437,500.00, | **97**, 2594. |
| 1898, | 770,138.00, | **98**, 2227. |
| 1899, | 300,000.00, | **99**, 2613. |
| 1900, | 793,187.50, | **1900**, 3557. |
| Total, | 3,183,124.70 | |

**Commerce.**

Interests of commerce set forth in detail in S. Doc. 68, 41st Cong., 2d sess.

Present needs of shipping, **89**, 2006.

Harbor Basin: Used much by a large commerce bound to West Superior, **93**, 2657; **94**, 2014; **95**, 2534; **96**, 2340.

[a] Allotted from $100,000 for Duluth and Bay of Superior.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part D.—Duluth Harbor, Minn.—Continued.

North Shore Channel: Increasing commerce, **93**, 2658; **94**, 2015; **95**, 2534; **96**, 2340.

Rices Point Channel: By far the most important part of the harbor improvement at the head of the lake, **93**, 2658; **94**, 2014; **95**, 2534; **96**, 2340.

The value of the lake commerce entering and leaving Duluth in 1895 was estimated at nearly $50,000,000, **96**, 2341; 1896, at $112,000,000, **97**, 2593; in 1897, at nearly $120,000,000, **98**, 2225.

Description of, **95**, 2542, 2543.

The commercial interests of Duluth and Superior identical and of great importance, **95**, 2579.

The great bulk of the commerce passing through the Sault Ste. Marie Canal, Mich., goes to the harbors of Duluth and Superior, **93**, 2659; **94**, 2016; **95**, 2535, 2580.

Construction of 20-f. channels recommended, **95**, 2535, 2580.

Comparative table of vessel commerce of a number of ports of the U. S. for 1896–97, which shows Duluth-Superior Harbor to be fourth in vessel tonnage and sixth in value of commerce by water alone, **98**, 2225.

**Contracts.**

**1871.** Munger & Gray, 10 cribs 50 f. by 30 f., **71**, 107.

**1873.** Munger & Gray, repairing piers, Duluth Canal, **73**, 131.

**1875.** Pardee & Dodge, dredging, 15 cents, **75**, 181.

**1877.** Williams & Upham, dredging, 14⅞ cents per c. y., **77**, 837.

**1879.** Williams & Upham, dredging, 12 cents per c. y., **79**, 1465; dredging, 14 cents per c. y., **80**, 1877.

**1880.** Williams & Upham, dredging, 16 cents per c. y., **81**, 2022.

**1881.** Williams & Upham, dredging, 14 cents per c. y., **81**, 2022.

**1882.** Williams & Upham, dredging, 16 cents per c. y., **83**, 1616.

**1884.** Williams & Upham, dredging, 14 cents per c. y., **85**, 1940.

**1887.** Williams, Upham & Co., dredging, 15½ cents per c. y., **87**, 1940. C. S. Baker, repairs to piers and placing buoys and construction of crib, **87**, 1941.

**1888.** Williams, Upham & Co., dredging, 15½ cents per c. y., **89**, 2004.

**1890.** Williams, Dougherty & Upham, dredging, 14 cents per c. y., **91**, 2492.

**1892.** F. H. Quinby and F. Omers, constructing protection crib and repairing canal pier, $10,000, **92**, 2130. Williams, Daugherty & Upham, dredging, 15 and 21 cents per c. y., **93**, 2662.

**1894.** Same firm, dredging, 13$\frac{4}{10}$, 15, and 20 cents per c. y., **95**, 2545. Dwyer & Amory, constructing two signal stations, $598, **95**, 2546. E. McCue, pier repairs, $5,699.35, **95**, 2546.

**1896.** West Duluth Land Co., dredging out dike, 40 cents per l. f. Williams, Green & Williams, dredging, 12 cents per c. y. C. S. Barker, dredging, 11¾ cents per c. y. **97**, 2596.

**1897.** S. Meneice, pier repairs, $552.25. Williams, Green & Williams, and also C. S. Barker, dredging, 7½, 8, and 10 cents per c. y. **97**, 2597. F. Davis, pier repairs, etc., $24,217.10. J. N. Dennis, pile dike construction, $4,995. Duluth Dredge and Dock Co., removing old dock, about $500. **98**, 2230. J. H. Carlson, furnishing and placing riprap at Superior entry piers, 71 cents per s. t., $28,400. Moran & O'Brien, building boathouse, $386.57. F. P. Tims, building boathouse, warehouse, dock, oilhouse, etc., about $3,000. **98**, 2231.

**1898.** King & Steele, building superstructure for south pier of canal entrance—dredging, timber, piles, rock, etc.—total, $170,779.50. C. B. B. Inman, removing wreck, $1,300. **98**, 2233. King & Steele, construction of concrete blocks for south pier of canal entrance, $4.95 per c. y. of concrete, **98**, 2234.

**1899.** Northwestern Lime Co., 12,000 bbls. Portland cement, $2.19 per bbl., **99**, 2615. Butler-Ryan Co., superstructure of north pier (dredging, 20 cents per c. y.; lumber, piles, iron work, rock, gravel, plant, cribs), $160,330, **99**, 2616. C. Stone, setting footing concrete blocks, south pier; building concrete superstructure, south pier; building and placing concrete footing blocks, north pier; $38,313.70, **99**, 2617.

**1900.** Northwestern Lime Co., 9,000 bbls., Portland cement, $2.29 per bbl. C. Stone, concrete superstructure of north pier; setting footing blocks, $41,796.40. **1900**, 3559.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 38; **71**, 30; **72**, 29; **73**, 29, 137; **74**, 35; **75**, 39; **76**, 93; **77**, 97; **78**, 111; **79**, 149; **80**, 200; **81**, 268; **82**, 264; **83**, 272; **84**, 271; **85**, 294; **86**, 287; **87**, 253; **88**, 229, **89**, 268, 274; **90**, 242, 247; **91**, 311; **92**, 297; **93**, 337; **94**, 309; **95**, 343, 352; **96**, 301; **97**, 386; **98**, 379; **99**, 449; **1900**, 514. Report to Secretary of War on the canal and dike and their effect on the harbor of Superior, Wis., **72**, 150. Directs the order of expenditure of the $100,000 appropriated for the works in this vicinity, **73**, 130.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part D.—Duluth Harbor, Minn.—Continued.

BOARDS OF ENGINEERS.

Convened at Milwaukee, Wis., 1870. Recommended the third plan, that for dredging. Reports, **70**, 125; **79**, 1472. (Col. Macomb, Lt. Col. Raynolds, Majs. Wheeler, Weitzel, and McFarland.)

Convened at Chicago, Ill., 1873. Recommended a certain order of expenditure of $100,000 appropriated for the works in this vicinity. Report, **73**, 129. (Col. Macomb, Lt. Col. Tower, Majs. Weitzel, Houston, and Farquhar.)

Convened at Duluth by S. O., No. 3, 1881. Report, **81**, 2026. (Maj. Houston and Capts. Mackenzie and Allen.)

A commission convened Sept. 24, 1894, under authority of S. O., No. 40, dated Aug. 18, 1894, to consider and report on the cost of deepening the harbors of Duluth and Superior to 20-foot depth. Report, **95**, 2539. (Gen. O. M. Poe, Maj. J. F. Gregory, and Maj. C. B. Sears.)

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1870. Report, **70**, 110.

Maj. D. C. Houston, 1871–73. Reports, **71**, 107; **72**, 105; **73**, 135.

Maj. F. U. Farquhar, 1873–78. Reports, **73**, 128; **74**, 131; **75**, 181; **76**, ii, 317; **77**, 837; **78**, 1127.

Capt. C. J. Allen, 1878–86. Reports, **79**, 1465; (Maj.) **80**, 1875; **81**, 2019; **82**, 2095; **83**, 1613; **84**, 1809; **85**, 1937; **86**, 1627.

Capt. J. B. Quinn, 1886–92. Reports, **87**, 1935; (Maj.) **88**, 1803; **89**, 2000; **90**, 2285, 2310, 2311; **91**, 2489.

Capt. W. L. Fisk, 1892. Report, **92**, 2126.

Maj. C. B. Sears, 1893–1900. Reports, **93**, 2657; **94**, 2014; **95**, 2533, 2579; **96**, 2339; **97**, 2592; **98**, 2223; **99**, 2611; **1900**, 3554.

ASSISTANTS:

Capt. J. W. Cuyler. Report, **70**, 111.

Capt. A. M. Miller. Report, **72**, 105.

T. Shiels, **79**, 1466; **80**, 1878.

J. P. Frizell. Report (historical sketch), **79**, 1470.

G. Wells. Reports, **82**, 2098; **84**, 1816.

S. L. Rice. Report, **90**, 2318.

Lt. G. D. Fitch. Report, **90**, 2320.

F. J. Dever. Reports (dredging), **99**, 2623; **1900**, 3569.

J. H. Darling. Reports (piers, maps), **99**, 2633; **1900**, 3566.

C. Coleman. Report (piers), **99**, 2644.

**Estimates.** (See *Plans* and *Projects.*)

Detailed, of Capt. Cuyler, for improvement, 3 plans, **70**, 113.

By Maj. Houston, for increasing the strength of the breakwater, $367,000, **73**, 135.

By Maj. Farquhar, 1874, for dredging 1,078,957 c. y., 25 cents, $269,739, **74**, 132; **76**, ii, 318; **77**, 838. For rebuilding dike, $87,199, **74**, 133. Repairs of piers, 1875, $6,305, **75**, 182; **76**, ii, 318.

**Legal proceedings.**

The ownership of the land occupied by canal entrances not invested in the United States, **93**, 2657; **94**, 2014; **95**, 2533; **96**, 2340. Efforts to secure ownership, **95**, 2533.

By condemnation proceedings the land on which the bench marks of the base line of the primary triangulation of Lake Superior were situated was procured in 1894–95, **95**, 2537.

Proposed rules and regulations for the government of navigation in the various channels, **95**, 2536. In 1897 the Secretary of War prescribed rules and regulations for using the channels of the harbor to the great convenience of vessel interests. These rules required rafts to use the Superior entrance and to keep out entirely of the Duluth Canal, and to use the raft spans of drawbridges instead of the drawspans. Copy of the rules, etc., **98**, 2226.

The city of Duluth deeded to the United States all its landed interests in and adjacent to the Duluth Canal. Condemnation proceedings instituted for the remainder of the land needed, **97**, 2593.

Acquirement of title to land needed for harbor improvement. Condemnation proceedings for, and purchase of land, **98**, 2224; **99**, 2611; **1900**, 3555. Condemnation for part of the land stopped because of exorbitant awards, **1900**, 3555.

**Legislation.**

Resolutions of legislature of Minnesota and report of its select committee on necessity for improvement of the harbor, S. Doc. 58, 41st Cong., 2d sess. Injunction by United States against Duluth Canal, **72**, 106.

Congress, 1894, authorized the opening of negotiations for the acquirement by the United States of ownership of the land on which are situated the canal entrances, **95**, 2533.

**Obstructions.**

The towing of large bag rafts obstructing waterways and of much inconvenience to vessel interests, **95**, 2536; **96**, 2341.

**Operations.**[a] [b]

**1871–72.** 10 cribs (50 f. by 30 f.) in extension of breakwater already built

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[a] Historical sketch of, **79**, 1470.

[b] Condition of breakwater, 1874–75, S. Doc. 29, 43d Cong., 1st sess.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part D.—Duluth Harbor, Minn.—Continued.

(400 f.) by Northern Pacific R. R. Co., **71**, 107. Extension 400 f., making total length 950 f., **72**, 105. Breakwater extensively repaired, **72**, 105.

**1872–73.** 5 cribs (50 f. by 30 f.) were placed in extension of the breakwater, **73**, 29, making it 1,200 f. long, **79**, 1473. Repairs to breakwater, **73**, 131. A storm in November, 1872, destroyed 650 f. of the South pier, **73**, 131. Extensions stated at 750 f. and repairs due to storm at 143 f., **74**, 131. Breakwater practically abandoned, **79**, 1474.

**1873–74.** Piers on each side of canal were rebuilt, revetments of same repaired, opening made through dike, and dredging in the inner harbor, costing, in all, $32,049.20, **74**, 132.

**1874–75.** 45,171½ c. y. dredged from harbor and repairs made on piers, **75**, 181.

**1875–76.** 169,544½ c. y. dredged, **76**, ii, 317. 40 acres being dredged; dike almost disappeared, urgent repairs needed, **75**, 182.

**1876–77.** 310½ cords of stone placed along face of north pier, **77**, 97, 837.

**1877–78.** Dredging through bar on north side of dike and in the inside harbor; 83,150 c. y. removed, **78**, 111, 1127.

**1878–79.** 158,179 c. y. dredged from inside harbor; 250 l. f. of cribwork renewed on north face of canal, **79**, 149. Total dredging in Duluth Harbor to June 30, 1879, 457,000 c. y., **79**, 1474.

**1879–80.** 168,508 c. y. dredged from inner harbor and area north of canal; repairs to piers; 150 l. f. revetment built at Wisconsin Point; 16,666 c. y. dredged from new cut, **80**, 1879, 1880.

**1880–81.** 113,158 c. y. dredged from inner harbor; repairs to south and old piers; 21,859 c. y. dredged from between piers, **81**, 2020.

**1881–82.** 194,169 c. y. dredged, of which 179,169 c. y. were by contract; repairs to piers, **82**, 2099, 2100.

**1882–83.** 114,492 c. y. dredged; 1,170 l. f. decking laid on north and south piers, **83**, 1614.

**1883–84.** 91,832 c. y. dredged, **84**, 1816, 1817.

**1884–85.** Pier-head repaired; 173,102 c. y. dredged, **85**, 1937, 1938.

**1885–86.** 63,186 c. y. dredged; 51 cords stone riprap placed in south pier, **86**, 1629.

**1887–88.** 159,940 c. y. dredged from harbor basin; general repairs to north and south canal piers, **88**, 1805.

**1888–89.** 172,860 c. y. dredged from Rice Point and North Shore channels, **89**, 2003.

**1890–91.** 234,366 c. y. dredged from Rice Point Channel, **91**, 2489.

**1891–92.** Dredging in North Shore Channel, **92**, 2127.

**1892–93.** *Rices Point Channel:* Much dredging done, **93**, 2658. *North Shore Channel:* Dredging in progress, **93**, 2658.

**1893–94.** *Rices Point Channel:* Over 50,000 c. y. dredged, **94**, 2014. *North Shore Channel:* Over 100,000 c. y. dredged, **94**, 2015. *Canal:* North pier repaired, **94**, 2014.

**1894–95.** *Canal Entrance:* Piers repaired, **95**, 2534. *St. Louis River above Grassy Point:* Dredging in progress, **95**, 2535.

Construction of permanent base marks of the primary triangulation of Lake Superior begun, **95**, 2537.

**1895–96.** *North Shore Channel:* Dredging done, **96**, 2340. *St. Louis River above Grassy Point:* Dredging of previous year completed, **96**, 2341.

The base marks in course of construction previous year completed, **96**, 2341.

**1896–97.** Dredging of about 26,000,000 c. y. in progress, **97**, 2593, 2596, 2597. Plans prepared for the construction of stone piers at the canal entrances of the Duluth Canal, and for the widening of the canal, **97**, 2594. Piers repaired, **97**, 2597.

**1897–98.** In connection with preceding year, 2,637,284 c. y. dredged. Construction of south pier of Duluth canal in progress, and pier at the Superior entrance strengthened, using of rock alone 13,299 tons. Wreck removed. **98**, 2224, 2225.

**1898–99.** 4,202,229 c. y. dredged; construction of new south pier under way; construction of substructure of new north pier begun; construction and placing of concrete footing blocks in progress; cements tested; piers strengthened and repaired, and 22,217 tons riprap placed; dike at Superior entrance repaired; (sketches of piers and concrete molds, etc.), **99**, 2611.

**1899–1900.** 4,920,387 c. y. dredged; superstructure new south pier completed; substructure of new north pier under way; footing blocks for piers made and some laid; strengthening of piers at Wisconsin entrance completed, **1900**, 3555.

**Physical characteristics.**

Description of, **70**, 111; **72**, 150; **79**, 1466, 1471; **89**, 2000.

*St. Louis River above Grassy Point:* Description of, and channel dimensions, **93**, 2659; **96**, 2340.

*North Shore Channel, St. Louis Bay:* Description of, and channel dimensions, **93**, 2658; **96**, 2340.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part D.—Duluth Harbor, Minn.—Continued.

*Rices Point Channel:* Channel dimensions, **93**, 2657; **95**, 2534.

Description of, **95**, 2539, 2540; **97**, 2592; **98**, 2223.

The harbor, held by Commission of 1894 to include all the navigable waters lying inside of Minnesota Point and along the fronts of the cities of Duluth and Superior, and the city limits, respectively, **95**, 2539.

Results obtained by works of improvement, **98**. 2223.

Table of distances in different channels and basins included in the harbor, **1900**, 3575.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Cuyler, breakwater, 2,622 f. long, to cost $387,253; canal, piers, and inner harbor, to cost $270,014; dredging for 12 f. on interior harbor, to cost $132,241. The latter adopted by Board of Engineers, **70**, 38, 125; **79**, 1472.

By Maj. Houston, to add 2,600 f. to breakwater built (400 f.) by Northern Pacific R. R. Co., **71**, 107; for increasing the strength of the breakwater, **73**, 135.

By Maj. Quinn, 1890, for construction of a timber and stone breakwater, two parallel crib-work piers, and dredging canal to 22 f.; estimate, $2,345,842, **90**, 2316.

**Private (city and corporate) work.**

By city of Duluth, 1870. the cutting of a canal through Minnesota Point to connect the lake with the bay, and a dike, **71**, 107; **79**, 1473. Canal enlarged to 250 f. wide, **72**, 105. Discussion of the canal and dike work and the effect on the harbor at entry of Superior Bay, **72**, 106; **79**, 1473. Report of the Chief of Engineers, giving a history of the injunction and proceedings in regard to this dike, **72**, 150, 159. More fully stated in S. Doc. 60, 42d Cong., 2d sess. Résumé of same, **79**, 1473. Report of special survey by Maj. Houston and W. H. Newton, **73**, 145. L. S. and M. R. R. Co. placed 200 cords of stone on side of north pier, **76**, ii, 318. 400 f. of breakwater built by the Northern Pacific R. R. Co., **71**, 107. Northern Pacific R. R. built extensive wharves and slips, **72**, 108.

**Projects.** (See *Estimates* and *Plans.*).

By Capt. Cuyler, dredging an interior harbor; adopted by Board of Engineers, **70**, 38, 125.

By Maj. Houston, to add 2,600 f. to breakwater built (400 f.) by Northern Pacific R. R. Co., **71**, 107.

Stated by Capt. Allen as providing for 16 f. depth in harbor at low water, and repairs and maintenance of the piers. Constant dredging required to amount of $50,000 per annum, **79**, 1466.

By Maj. Farquhar, 1874, to afford by dredging a 16 f. anchorage in the harbor. Estimated cost, $269,739.25, **74**, 132; **80**, 200.

By Board of Engineers, 1881, for maintenance of dredged areas, enlargement of harbor by dredging to accommodate vessels drawing 16 f., and maintenance of piers bordering canal; estimate, $212,988.36, **81**, 2026; **86**, 1627.

Revised in 1884 by Maj. Allen, making total cost of above project $305,424, **84**, 1811; **86**, 1628; **87**, 1940.

By Capt. Quinn, 1887, for dredging Rice Point Channel to 16 f.; estimate, $119,552, **88**, 1805. Total cost of projected improvement, $332,540, **88**, 1807.

*Canal:* Description of works constructed, **93**, 2657; **94**, 2014; **95**, 2534.

*St. Louis River above Grassy Point:* By Capt. Fisk, 1891, for dredging a channel where necessary 100 f. wide at bottom and 16 f. deep up to Fond du Lac. Estimate, $113,000, **92**, 2151; **93**, 2659.

By Board of Engineers (Commission) for widening and deepening to 20 f. the existing channels improved under previous projects for depth of 16 f.; for a new channel, 20 f. deep, along Minnesota Point dock line; for new channels in Allouez Bay (see *Allouez Bay*); for extensive turning and anchorage basins 20 f. deep at junctions of two or more channels; for widening Duluth canal; and for replacing with substantial structures of timber and monolithic concrete the piers at the Duluth canal and Wisconsin entrances. Estimate, $1,806,667 for Duluth Harbor, and $1,323,886 for Superior Harbor, **95**, 2540–2542; **96**, 2339; **97**, 2593; **98**, 2224.

Act of June 3, 1896, consolidated the works of improvement at Duluth and Superior, and provided for continuous contracts amounting to $3,080,553, **96**, 2339; **99**, 449.

**Surveys.**

Under Maj. Wheeler, by Capt. Cuyler, **69**, 29; **70**, 38, 111; **79**, 1472. Special survey by Maj. Houston and W. H. Newton, **73**, 145. (See *Superior Bay.*)

Of harbor made, 1880, under direction of Capt. Allen, **80**, 1876.

Ordered by act of Aug. 11, 1888, made, 1890, under direction of Maj. Quinn, **90**, 2311.

Congress by act of July 13, 1892, ordered an investigation of the ownership of the land occupied by the canal entry, etc., made by Maj. Sears in 1892, **93**, 2664.

## DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—Continued.

### Part D.—Duluth Harbor, Minn.—Continued.

By joint resolution, Congress directed the Secretary of War to appoint a commission of three engineers to examine the harbors of Duluth and Superior, etc., to ascertain the cost of obtaining 20 f. depth for report to Congress. Report made in 1894 (see *Projects*), **95**, 2538.

Examination of Superior and Duluth harbors with a view to obtaining a depth of 20 f. ordered by act of Aug. 17, 1894, made by Maj. Sears, 1895 (report favorable), **95**, 2579.

MAPS. **82**, 2102; **85**, 1944; **86**, 1632; **87**, 1944; **91**, 2490; **93**, 2658; **98**, 2226 (sketches of piers, and concrete molds, etc.,); **99**, 2702.

### PART E.—Minnesota Point, Superior Bay, Minn.

**Appropriation.**

**1890.** [a]$4,895, **91**, 2499.

**Contract.**

**1891.** Campbell & McDonald, sand-fence construction, $3.45 per running f., **91**, 2499.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 274; **90**, 247; **91**, 313; **92**, 299.

ENGINEERS IN CHARGE:

Maj. J. B. Quinn, 1888–91. Reports, **90**, 2306, 2307.

Capt. W. L. Fisk, 1891–92. Reports, **91**, 2499; **92**, 2137.

**Operations.**

**1890–91.** 1,216 l. f. of sand fence built, completing the project, **91**, 2499.

**Physical characteristics.**

Description of, **90**, 2306.

**Projects.**

By Maj. Quinn, 1889, to preserve Minnesota Point from the inroads of the lake by the construction of 1,216 l. f. of sand fence. Estimate, $4,895, **90**, 2308.

Project completed in 1891, **91**, 2499.

**Survey.**

Ordered by act of August 11, 1888, made, 1888, under direction of Maj. Quinn, **90**, 2307.

### Part F.—Allouez Bay, Wis. (See Part D; also *Nemadji River*.)

**Commerce.**

Description of, **93**, 2693; **95**, 2551, 2585.

Extensive docks built in 1892 and subsequent years for shipment of ore, etc. (see references above).

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 344; **95**, 352.

ENGINEER IN CHARGE. Maj. C. B. Sears, 1893–95. Reports, **93**, 2692; **95**, 2584.

**Physical characteristics.**

Description of, **93**, 2693; **95**, 2585.

Empties into Superior Bay near its southern end and almost opposite the United States piers which define the Superior entrance, is some 3,900 y. in length, and has an average width of 1,300 y., **93**, 2693. It forms a part of the harbor of Superior West, the city limits extending beyond its most easterly boundary. Its topography makes it a good, natural site for the location of ore docks, etc., **95**, 2585.

**Private (corporate) work.**

In 1892 the Duluth and Winnipeg Railroad Co. had dredged a channel 3,700 f. long, 75 f. wide, and 18 f. deep at a cost of $195,000, and expected to spend for other improvements in the harbor the sum of $592,000, **93**, 2693.

**Projects.**

By Maj. Sears, dredging to 20 f. depth in the bay as part of the dredging for the improvement of Duluth-Superior harbor. Estimate, $289,810. **95**, 2586.

**Surveys.**

Examination ordered by act of July 13, 1892, made, 1892, by Maj. Sears (report favorable), **93**, 2692.

Survey ordered by act of August 17, 1894, made, 1894, by Maj. Sears (see *Projects*), **95**, 2585.

Harbor lines were established by the Secretary of War in 1893, **95**, 2586.

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[a] Unexpended money, $45.92, turned into Treasury, 1893, **93**, 2673.

## DUNKIRK HARBOR, N. Y.

### Appropriations.

| | | |
|---|---|---|
| 1827, | $3,000.00, | **66**, iii, 31. |
| 1828, | 6,000.00, | **66**, iii, 31. |
| 1829, | 9,812.75, | **66**, iii, 31. |
| 1830, | 1,342.75, | **66**, iii, 31. |
| 1831, | [a] 6,400.00, | **66**, iii, 31. |
| 1831, | 702.50, | act Mar. 2. |
| 1832, | 10,200.00, | **66**, iii, 31. |
| 1834, | 4,000.00, | **66**, iii, 31. |
| 1835, | 10,988.43, | **66**, iii, 31. |
| 1836, | 11,000.00, | **66**, iii, 31. |
| 1837, | 15,000.00, | **66**, iii, 31. |
| 1838, | 10,000.00, | **66**, iii, 31. |
| 1844, | 5,000.00, | **66**, iii, 31. |
| 1852, | 30,000.00, | **66**, iii, 31. |
| 1867, | 100,000.00, | **67**, 138, 221; **68**, 198. |
| 1869, | 2,000.00 | (allotment), **70**, 30, 51, 187. |
| 1870, | 25,000.00, | **70**, 51, 187; **71**, 49. |
| 1871, | 25,000.00, | **71**, 49. |
| 1872, | 25,000.00, | **72**, 45. |
| 1873, | 40,000.00, | **73**, 45. |
| 1874, | 35,000.00, | **74**, 52. |
| 1875, | 35,000.00, | **75**, 57, 317. |
| 1876, | 18,000.00, | **76**, 109, ii, 568; **77**, 116. |
| 1879, | 2,500.00 | (allotment), **79**, 1716. |
| 1880, | 10,000.00, | **80**, 2192. |
| 1884, | 10,000.00, | **84**, 2125. |
| 1886, | 20,000.00, | **86**, 1876. |
| 1888, | 15,000.00, | **88**, 2027. |
| 1890, | 20,000.00, | **90**, 2807. |
| 1892, | 20,000.00, | **92**, 2529. |
| 1894, | 20,000.00, | **95**, 3145. |
| 1896, | 10,000.00, | **96**, 3107. |
| 1897, | 398,258.00, | **97**, 3105. |
| Total, | 959,837.38 | |

### Commerce.

Requirements of, discussed, **75**, 318; **76**, ii, 557; **77**, ii, 971. Requirements of, will not justify further extension of breakwater, **77**, ii, 971.

STATISTICS, S. Doc. 42, 35th Cong., 1st sess., **66**, iii, 31, iv, 157; **67**, 231; **68**, 197; **69**, 149; **70**, 189; **72**, 247; **73**, 348; **74**, 225; **75**, 318; **76**, ii, 567; **78**, 1268; **79**, 1717.

Description of, **93**, 3121, 3130; **95**, 3174.

Local and not large, 1899, but arrangements made for its increase, **1900**, 4149.

### Contracts.

**1867.** Alex. McDonnell, labor and materials, **67**, 232, 233; **68**, 197. R. N. Gere, iron, **68**, 197.

**1868.** Hart & Jennings, labor and materials, **69**, 150; **70**, 189. Pratt & Co., iron, **69**, 150; **70**, 189.

**1869.** Bailey & Denny, materials, **69**, 150; **70**, 189.

**1871.** O. J. Jennings, materials and labor, **71**, 213; **72**, 247.

**1872.** O. J. Jennings, materials and labor, **73**, 350; **74**, 226.

**1873.** O. J. Jennings, materials, labor, and dredging, **73**, 350; **74**, 226.

**1874.** Cartwright, McCurdy & Co., iron, **73**, 350; **74**, 226. O. J. Jennings, materials and labor, drilling, blasting, and dredging, **75**, 319. Cartwright, McCurdy & Co., iron, **75**, 319.

**1875.** Spaulding & Bennett, materials and labor, **75**, 319. William H. McCurdy & Co., iron, **75**, 319.

**1876.** Case & Jennings, drilling, blasting, and dredging, **76**, ii, 568.

**1877.** O. J. Jennings, materials and labor, **77**, ii, 971. William H. McCurdy, iron, **77**, ii, 971.

**1878.** O. J. Jennings, removal of wreck and dredging, **79**, 1716.

**1881.** G. W. White, material and labor, **81**, 2419. F. B. Gay, iron, **81**, 2419.

**1884.** Hingston & Woods, dredging and breakwater repair, **85**, 2248.

**1887.** G. Elias & Bro., timber, **87**, 2349. D. McNaughton, iron, **87**, 2349.

**1889.** Hingston & Woods, dredging, 27 cents per c. y. for mud and $1 for loose rock, **89**, 2358.

**1891.** G. C. Grimard, construction and repair of breakwater and piers, $14,970, **91**, 2880.

**1892.** D. E. Horton, repairs to breakwater and pier, approximate total of bid, $12,859.18; H. K. Gustin, extension of breakwater, approximate total of bid, $15,114.56 (annulled, **94**, 2435), **93**, 3106.

**1893.** J. B. Donnelly, breakwater extension, approximate total of bid, $14,749.65, **94**, 2435.

**1894.** Hingston & Woods, dredging, $9.67 per hour; J. B. Donnelly, breakwater extension, approximate total of bid, $13,752.28, **95**, 3145.

**1897.** E. J. Hingston, channel and harbor excavation, repairs to west pier, construction of breakwater, and extension of, approximate total of bid, $321,386.85, **97**, 3106. Supplementary contracts for extra work, **98**, 2749, 2753.

### Defense.

This harbor necessary for our Navy in time of war, S. Doc. 42, 35th Cong., 1st sess.

### Engineers.

CHIEF OF ENGINEERS. Reports, **66**, 7, ii, 41, iii, 15, 31; **67**, 31; **68**, 43, 198, 201; **69**, 39, 162; **70**, 50, 190; **71**, 48, 214; **72**, 45; **73**, 45; **74**, 57; **76**, 109; **77**, 116; **78**, 131; **79**, 174; **80**, 229; **81**, 315; **82**,

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[a] Erroneously called $6,000; act Mar. 2, 1831, **66**, iii, 31.

**DUNKIRK HARBOR, N. Y.**—Continued.

309; **83**, 316; **84**, 320; **85**, 343; **86**, 338; **87**, 304; **88**, 278; **89**, 330; **90**, 298; **91**, 374; **92**, 353; **93**, 405, 409; **94**, 379; **95**, 414, 418; **96**, 370, 376; **97**, 464; **98**, 456; **99**, 537, 543; **1900**, 605, 611.

BOARDS OF ENGINEERS. (See also *Projects*).

1869. To consider modified plan of breakwater proposed by Col. Harwood; recommend: 1st, riprap on harbor side of the portion built; 2d, increase in width of extension from 20 f. to 24 f.; 3d, grillage bottom. Report, **70**, 191.

1870. To prepare plan and estimate for harbor improvement; recommend: 1st, reconstruction of "dummy" crib for a day beacon; 2d, construction of breakwater inside of former breakwater on plan proposed by Capt. Harwood (see **70**, 193–197), with slight modifications; 3d, blasting and dredging channel 170 f. by 13 f. from entrance to anchorage, **71**, 214–217.

(Lt. Col. Woodruff, Maj. McFarland, and Capt. Harwood.)

ENGINEERS IN CHARGE:

Capt. W. G. Williams, 1839; **66** iv, 155.

Capt. Wm. Turnbull, 1855–56. Report, S. Doc. 1, pt. 2, 34th Cong., 1st sess.; extracts from, in S. Doc. 42, 35th Cong., 1st sess.

Lt. Col. Graham, 1857. Report S. Doc. 42, 35th Cong., 1st sess.

Capt. J. A. Tardy, 1866. Report, **66**, iv, 155.

Col. T. J. Cram, 1867–68; **67**, 137, 148, 221.

Maj. F. Harwood, 1868–74. Reports, **68**, 195; **69**, 147–153, 154, 155–162; **70**, 186, 189, 190, 191–198; **71**, 213; **72**, 246; **73**, 347; **74**, 225.

Lt. Col. C. E. Blunt, 1874–78; **74**, 215. Reports, **75**, 317; **76**, ii, 566; **77**, ii, 970.

Maj. W. McFarland, 1878–83. Reports, **78**, 1267; **79**, 1715; **80**, 2191; **81**, 2417; **82**, 2429.

Capt. M. B. Adams, 1883–84. Report, **83**, 1927.

Capt. E. Maguire, 1884–85. Report, **84**, 2124.

Maj. L. C. Overman, 1885–86. Reports **85**, 2246; **86**, 1874.

Capt. F. A. Mahan, 1886–90. Reports, **87**, 2348; **88**, 2024; **89**, 2356.

Maj. A. Stickney, 1890–92. Reports, **90**, 2804; **91**, 2878.

Maj. E. H. Ruffner, 1892–95. Reports, **92**, 2527; **93**, 3103, 3119; **94**, 2434; **95**, 3143, 3173.

Maj. T. W. Symons, 1896–. Reports, **96**, 3106, 3127; **97**, 3103; **98**, 2748; **99**, 3096; **1900**, 4108, 4148, 4150.

ASSISTANTS:

J. S. Lawrence, **66**, iv, 164.

Capt. F. Harwood, **67**, 137, 221; **68**, 199.

Mr. Mifflins, **68**, 202.

**Estimates.** (See *Plans* and *Projects.*)

By Board of Engineers, 1854, for completing the work, $192,600.81; revised by Lt. Col. Graham to $401,818.66, S. Doc. 42, 35th Cong., 1st sess.

By Capt. Tardy, for crib work, $267,130.20, **66**, iii, 15, 31; for crib work, with masonry superstructure, $433,977.46, **66**, iv, 157.

By Col. Cram, to complete the work, $148,584, **67**, 138.

By Capt. Harwood, for permanent completion, $404,500, **68**, 197; for opening east channel and for an auxiliary breakwater, $155,684.78, **68**, 204; for entire and permanent completion, $407,894.10, **69**, 149; for entire and permanent completion, $505,213.06, **70**, 188; for buttress cribs, 8 f. by 30 f., $326.93; 10 f. by 30 f., $367.89, **69**, 159.

By Board of Engineers, $331,000, **71**, 216.

By Capt. Harwood, to complete project of the Board of Engineers, $306,000, **72**, 247; $275,000, **73**, 348; $100,000, **74**, 226.

By Lt. Col. Blunt, necessities of commerce require, $18,000, **76**, ii, 567; to complete existing project, $31,000, **77**, ii, 971.

By Maj. McFarland, to complete existing project, $262,000, **79**, 174, 1717. Modification proposed and recommended to meet present requirements, $31,000, **79**, 1716.

**Operations.**[a]

**1855–56.** 8 cribs, 30 f. by 19 f., placed in position; five of them injured by ice; injury repaired, S. Doc. 42, 35th Cong., 1st sess.

**1867–68.** Repairs of pier connecting beacon light with mainland, **68**, 43.

**1868–69.** 7 cribs, 210 l. f., of the west pier carried away, repaired; reinforcement in consequence. The construction of the new breakwater begun. **69**, 39, 148.

**1869–70.** West pier finished; removal of old outer breakwater; 390 f. of new breakwater constructed, **70**, 50, 193.

**1870–71.** West pier repaired and reinforced; removal of outer breakwater completed; reconstruction of day beacon and building about 200 f. of breakwater under contract, **71**, 213.

**1871–72.** "Dummy" and 210 f. of breakwater built; repairs to west pier; dredging in channel and approaches begun, **72**, 45, 246.

[a] Early history of, **66**, iv, 155.

## DUNKIRK HARBOR, N. Y.—Continued.

**1872–73.** 360 f. of breakwater completed; bar removed by dredging, making channel 13 f. deep, **73**, 45, 347.

**1873–74.** 2,375 c. y. rock removed; 8,500 c. y. sand dredged; breakwater extended westerly to its edge; 60 f. of substructure added to east end, **74**; 52, 225.

**1874–75.** 4 cribs, 120 f., sunk; 60 f. superstructure built, and 120 f. of superstructure without oak slope or decking, **75**, 57.

**1875–76.** 120 f. superstructure completed; 7 cribs, 210 f., breakwater finished; total length, 828 f.; 4,465 c. y., mostly rock, removed from channel, **76**, 109, ii, 567.

**1876–77.** Channel completed 170 f. wide 13 f. deep; west pier repaired, **77**, 116, ii, 970.

**1877–78.** Breakwater extended 251 f., **78**, 131, 1268.

**1878–79.** Repairs to west pier; removal of wreck and dredging, **79**, 1715, 1716.

**1881–82.** 150 l. f. of crib work placed and superstructure commenced, **82**, 2430.

**1884–85.** 13,318 c. y. dredged for channel, 100 l. f. of face timbers removed, **85**, 2246.

**1885–86.** 23,317 c. y. excavated, **86**, 1875.

**1886–87.** Repairs to west breakwater, **87**, 2348. History of work, **87**, 2348.

**1887–88.** 9 cribs sunk in repair of west pier; breakwater harbor wall rebuilt, and decking repaired, **88**, 2026.

**1888–89.** Repairs to west pier by hired labor, **89**, 2358.

**1889–90.** Extensive repairs to west pier by hired labor; 14,370 c. y. of mud and 120 c. y. loose stone removed under contract, **90**, 2805.

**1891–92.** Construction of west pier superstructure; 2,900 c. y. dredged, **92**, 2528.

**1892–93.** Pier and breakwater superstructure repaired, **93**, 3103, 3104.

**1893–94.** 250 f. of extension to breakwater completed, minor repairs made to west pier, and 22,727 c. y. dredged, **94**, 2435.

**1894–95.** Minor repairs were made to west pier and breakwater extended 400 f., **95**, 3143.

**1896–97.** 111,612 c. y., p. m., dredged and breakwater construction in progress, **97**, 3105.

**1897–98.** 442,629 c. y., p. m., excavated and removed, **98**, 2751; 582 f. of breakwater constructed, **98**, 2751, 2752; repairs to west pier in progress, **98**, 2752; and minor repairs made to structures, **98**, 2755.

**1898–99.** 91,415 c. y. dredged; work on concrete superstructure of west pier completed and protected with riprap stone; breakwater extension completed; minor repairs made. Project completed. **99**, 3097–3100. Photographs, **1900**, 4108.

**1899–1900.** Repair of west pier, **1900**, 4110.

**Physical characteristics.**

Description of, **66**, iii, 15, iv, 155; **68**, 199, 205; **69**, 156, 162; **70**, 194–196; **88**, 2027; **93**, 3121, 3122; **95**, 3175; **96**, 3128; **98**, 2755; **1900**, 4148–4150.

Storms damaging west pier, **99**, 3097.

**Plans.** (See *Estimates* and *Projects.*)

By Col. Cram, various plans for north pier, basin, etc., **68**, 198–205.

By Maj. Harwood, for buttress cribs to reinforce pier, **70**, 193–197.

Lt. Col. Blunt considers the building of the breakwater to the full length unnecessary, **75**, 318, **76**, ii, 567; **77**, 971.

**Private work.**

A survey of the harbor was made by citizens of Dunkirk in 1895–96, **96**, 3128.

**Projects.** (See *Estimates* and *Plans.*)

Original, for a west pier and breakwater of crib work in from 8 f. to 12 f. of water, **66**, iv, 155.

By Board of Engineers, 1854, 3 distinct breakwaters, eastern, middle, and western, on a line from Light-House Point to Battery Point, in 18 f. of water, **66**, iv, 155; **67**, 221; estimate, $192,600.81; increased by Lt. Col. Graham, 1857, to $401,818.66, S. Doc. 42, 35th Cong., 1st sess.

By Capt. Tardy, 1866, refers to former projects and recommends returning to the original; urges superstructure of masonry; estimates for wood superstructure, $267,130.20; for masonry superstructure, $433,977.46, **66**, iv, 156, 157.

By Col. Cram, 1867, recommending Capt. Tardy's plan, except in preferring wood to masonry superstructure; estimate, $148,584, **67**, 137, 138, 221.

By Capt. Harwood, 1868, removing old outer breakwater to 14 f. depth of water, **68**, 43, 196; repair and reenforcement of pier by buttress cribs on lake side, **69**, 155, 162; buttress cribs on land side instead of lake side, **70**, 189, 190; riprap on land side instead of buttress cribs, **70**, 190.

By Board of Engineers, 1869, increasing the width of the cribs from 20 f. to 24 f. and constructing them with grillage bottoms, **70**, 191.

By Board of Engineers, 1870, reconstructing "dummy" crib as a day beacon; constructing 2,860 f. of breakwater and an east pier; also blasting and dredg-

## DUNKIRK HARBOR, N. Y.—Continued.

ing in the channel to 13 f.; estimate, $331,000; revised estimate, $275,000, **71**, 216; **76**, ii, 567. Modified in 1873 to extension of breakwater 180 f. west, **73**, 45, 347; **80**, 229; **81**, 315; **87**, 2348.

By Maj. McFarland, 1879, proposed modifications, by extending the breakwater 510 f. instead of 1,109 f.; estimated cost to complete, $31,000, **79**, 174, 1716.

By Capt. Adams, 1883, for 860 l. f. of breakwater extension. Estimate, $60,200. **83**, 1928.

In 1890 Maj. Stickney estimated that to complete the improvement as projected, without repair to existing structures, would require, including the appropriation of 1890, $147,916, **90**, 2807; **91**, 2878.

By Maj. Ruffner, 1896, completing the breakwater by the addition of 310 f. to its eastern end and adding to the channel arm 560 f., and in addition thereto dredging an entrance channel to the harbor basin containing in all about 65 acres to a depth at mean lake level suitable for vessels drawing 16 f.; estimate, $408,258, **96**, 3107.

In 1899 Maj. Symons estimated it would cost $74,827.50 for a 1,300 f. long arm to existing breakwater, **1900**, 4152.

**Surveys.**

Soundings by Lts. Brown and Morell, 1835, **68**, 203.

Under direction of Capt. Tardy, by J. S. Lawrence, 1866, **66**, ii, 41, iii, 15. Report, **66**, iv, 155.

Under direction of Maj. Harwood, 1872, **72**, 246.

Examination to secure a depth of 16 f. ordered by act of July 13, 1892, made in that year by Maj. Ruffner (report of division engineer unfavorable), **93**, 3119.

Examination ordered by act of Aug. 17, 1894, made the same year by Maj. Ruffner (report of division engineer unfavorable), **95**, 3173.

Survey ordered by act of Mar. 4, 1895, made in the same year by Maj. Ruffner (see *Projects*), **96**, 3127.

Hydrographic survey to determine the location of the 19 f. curve was made in 1898 by Maj. Symons, **98**, 2755.

Examination and survey for easterly breakwater ordered by act of Mar. 3, 1899; examination made (survey not required) by Maj. Symons (report favorable; see *Projects*), **1900**, 4148.

MAPS. **79**, 1716; **81**, 2418; **84**, 2124; **97**, 3106; **98**, 2754.

PHOTOGRAPHS. (See *Operations, 1899.*)

## DURHAMS ESTUARY, N. C.

**Commerce.**

Small and not of sufficient importance to warrant improvement of stream, **93**, 1456, 1457.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 183.

ENGINEER IN CHARGE. Maj. W. S. Stanton, 1892–93. Report, **93**, 1454.

**Physical characteristics.**

The estuary a branch of Pamlico River, entering it 16½ miles below the town of Washington, **93**, 1454.

Description of, **93**, 1455.

**Survey.**

Examination ordered by act of July 13, 1892. of the estuary from its mouth to village of Edwards Mill, made, 1892, by Maj. Stanton (report unfavorable), **93**, 1454.

**DUWAMISH RIVER, WASH.** (See *Black River; Puget Sound and tributaries.*)

## DUXBURY BEACH AND HARBOR, MASS.

**Appropriations.**

1836, $5,000, act July 4.
1872, 10,000, **72**, 93.
1873, 10,000, **73**, 104.
1899, 12,000, **99**, 1086.

Total, 37,000

**Commerce.**

Absence of, **66**, ii, 36.

Obstructions to, **72**, 947.

Benefit of improvement, **72**, 964, 965.

Petition of citizens praying for improvement, **72**, 968.

Description of, **97**, 860.

**Contracts.**

**1872.** A. R. Wright, dredging, 50 cents per c. y.; contract extended, **73**, 1098.

**1873.** Hugh Cummiskey, dredging, 49 cents per c. y., **73**, 1098.

**1899.** A. B. Martin, dredging 44,042 c. y., 23.5 cents per c. y.; bowlder removal over 3 tons, $5 per c. y., **1900**, 1210.

**Defense.**

Field works in vicinity, at Gurnet and Saquish Head, **66**, ii, 36.

## DUXBURY BEACH AND HARBOR, MASS.—Continued.

**Engineers.**

Chief of Engineers. Reports, **66**, ii, 35; **67**, 46; **71**, 96; **72**, 93; **73**, 104; **74**, 115; **88**, 32; **97**, 63, 64; **99**, 78; **1900**, 89.

Engineers in Charge:

Col. J. G. Totten, 1836; **66**, ii, 36.

Maj. G. H. Mendell, 1866. Report, **66**, ii, 35.

Capt. J. A. Smith, 1867. Report, **67**, 456.

Lt. Col. G. Thom, 1872–74. Reports, **72**, 947, 963; **73**, 1097; **74**, ii, 322.

Lt. Col. G. L. Gillespie, 1888. Report, **88**, 472, 473.

Lt. Col. S. M. Mansfield, 1897. Reports, **97**, 860, 862.

Col. C. R. Suter, 1899–. Reports, **99**, 1085; **1900**, 1209.

Assistants:

G. B. Weston, **66**, ii, 35.

S. Haagensen. Reports, **72**, 965; **88**, 475.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Mendell, for repairs, $4,000, **66**, ii, 36.

By S. Haagensen, for dredging western channel, $66,000 and $37,600, **72**, 964, 966.

**Operations.**

**1836.** Rows of stakes driven and the space inclosed filled in with brush and sea weed, to collect and retain sand, **66**, ii, 36.

**1872–73.** 2,638 c. y. dredged, **73**, 1098.

**1873–74.** 32,020½ c. y. dredged, **74**, ii, 323.

**1899–1900.** 43,928 c. y. dredged, **1900**, 1209.

**Physical characteristics.**

General, **66**, ii, 36; **72**, 966.

Description of Duxbury Beach, **97**, 862.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Mendell, repairs, **66**, ii, 36.

By S. Haagensen, dredging western channel: 1st, to give a depth of 6 f.; 2d, to give a depth of 4 f. at m. l. w., **72**, 964, 966.

**Projects.** (See *Estimates* and *Plans.*)

By Col. Totten, 1836, planting 2 rows of stakes, 3 or 4 f. apart, and filling the inclosed spaces with brush and seaweed, to collect and retain the sand, **66**, ii, 36.

By Lt. Col. Thom, dredging Miles Channel to a width of 200 f. and a depth of 8 f. at m. l. w., together with the preservation of the beach, estimate $20,000, **72**, 947, 964.

By Lt. Col. Gillespie, 1887, improvement of the western branch of the Duxbury Channel by dredging a cut 3,600 f. long, 60 f. wide, and 6 f. deep at m. l. w., estimate. $13,200, **88**, 474.

By Col. Suter, 1899, expending $650 in examining channel, **99**, 1085.

By Col. Suter, 1899, modifying project of 1886 by relocating channel proposed, making it 60 f. wide in straight section and 100 f. wide in curved section; estimated cost revised, increasing it to $17,820, **1900**, 1209.

**Surveys.**

Examination by Maj. Mendell, 1866, **66**, ii, 35.

Examination, 1867. Report by Maj. Mendell, **67**, 456.

By S. Haagensen, 1871. Report, **72**, 965.

Under the direction of Lt. Col. Thom, 1872, **73**, 1097.

Ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. Gillespie, **88**, 473.

Examination of the harbor ordered by act of June 3, 1896, made by Lt. Col. Mansfield, 1897 (report favorable), **97**, 860.

Examination of Duxbury Beach ordered by act of June 3, 1896, made by Lt. Col. Mansfield, 1897 (report unfavorable), **97**, 862.

Survey made, 1899, by Col. Suter, **1900**, 1209.

Maps. **88**, 474.

## EAGLE HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1866, | $65,000, | **68**, 89. |
| 1875, | 10,000, | **75**, 41. |
| 1876, | 12,000, | **76**, 94. |
| 1878, | 8,000, | **78**, 113. |
| 1879, | 2,000, | **79**, 151. |
| Total, | [a] 97,000 | |

**Commerce.**

Local, **68**, 91; **70**, 91. Increase of, **75**, 41, 188.

Requirements of commerce as to harbor of refuge, **76**, ii, 328; **77**, 847.

Eagle Harbor compared with Copper Harbor, **76**, ii, 328.

Distances from Eagle Harbor to ports in vicinity, **76**, ii, 329.

Unimportant, **77**, 98, 847; **78**, 1133, 1139.

Average length of season of navigation 198 days, **77**, 850.

**Contracts.**

**1867.** D. Quinn, removal of rock, $58 per c. y., **67**, 57.

**1869.** G. W. Townsend, removal of rock, $40 per c. y., **69**, 24, 72.

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[a] In 1896 the $1,007.23 remaining unspent was returned to the Treasury, **96**, 2357.

**EAGLE HARBOR, MICH.**—Continued.

**1870.** R. Dunbar, removal of rock, **71**, 108.

**1878.** C. P. McDougall, building and placing cribs, $6,542.48, **79**, 1481.

**1885.** W. P. Raley, removal of obstructions; unsatisfactory progress of contract, **85**, 1970.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, iii, 8; **67**, 20; **68**, 27; **69**, 24; **70**, 33; **71**, 31; **72**, 30; **73**, 31; **74**, 36; **75**, 41; **76**, 94; **77**, 98; **78**, 112; **79**, 151; **80**, 202; **81**, 272; **82**, 267; **83**, 275; **84**, 274; **85**, 297; **86**, 291; **87**, 257; **88**, 233; **89**, 272; **90**, 245; **91**, 315; **92**, 300; **93**, 341; **94**, 312; **95**, 349.

ENGINEERS IN CHARGE:

Maj. W. F. Raynolds, **66**, ii, 41. Report and estimate, **66**, iv, 83.

Maj. J. B. Wheeler, 1867–70; **67**, 20. Reports, **68**, 92; **69**, 71, 73.

Capt. J. W. Cuyler, 1870. Temporarily in charge, **70**, 33.

Maj. D. C. Houston, 1870–73. Reports, **70**, 91; **71**, 108; **72**, 113.

Maj. F. U. Farquhar, 1873–75. Reports, **73**, 137; **74**, 135.

Maj. H. M. Robert, 1875–83. Reports, **75**, 187; **76**, ii, 323; **77**, 845; **78**, 1133; **79**, 1480; (Lt. Col.) **80**, 1900; **81**, 2036; **82**, 2115.

Capt. F. A. Hinman, 1883–84. Report, **83**, 1632.

Lt. Col. J. W. Barlow, 1884–85. Reports, **84**, 1828; **85**, 1970.

Capt. C. E. L. B. Davis, 1885–89. Reports, **86**, 1641; **87**, 1970; (Maj.) **88**, 1821.

Maj. J. B. Quinn, 1889–90. Reports, **89**, 2020; **90**, 2299.

Capt. W. L. Fisk, 1890–92. Reports, **91**, 2505; **92**, 2141.

Maj. C. B. Sears, 1893–96. Reports, **93**, 2679; **94**, 2028; **95**, 2560; **96**, 2357.

ASSISTANTS:

H. Bacon, **67**, 20, 60. Reports, **68**, 89, 93; **69**, 75.

Capt. J. W. Cuyler, **69**, 71.

Louis Y. Schermerhorn, C. E., in local charge from March, 1875, to completion of work in 1879, **78**, 1133. Reports, **76**, ii, 323; **77**, 845, 851; **78**, 1133; **79**, 1481.

J. F. Huston, **77**, 849; **78**, 1140.

C. L. Turner, 1879.

**Estimates.** (See *Projects.*)

History of estimates, **74**, 135; **77**, 845.

By Maj. Wheeler (rock, at $58 per c. y.), channel 80 f. wide, $184,024, **68**, 28; or for channel 130 f. wide, $261,294, **68**, 28. (Bacon's estimate, $237,321.12, **68**, 92.)

Revised by Maj. Farquhar (rock, at $50 per c. y.), ($231,570.64+amount expended, $41,792.72), $273,362, **74**, 136; **77**, 845.

Revised by Maj. Robert on basis of rock work done (channel 130 f. wide), $58 and $40 per c. y. by contract, and $10.83 per c. y. by hired labor, with guiding cribs instead of breakwater, $97,000, **77**, 98, 845. Estimate for guiding cribs, **77**, 848, 849; **78**, 1139. For dredging, **77**, 848.

**Operations.**

History of, **74**, 135. Proposals opened June 20, 1867; all bids rejected and new called for, **67**, 21.

**1867–68.** Contract with David Quinn, of Chicago (August 10, 1867), for removal of rock, at $58 per c. y., **67**, 57. Difficulties, **68**, 91. 100 c. y. of rock removed, **68**, 28, 91. Surface blasting failed, **68**, 91, 94; **69**, 74, 77. Result of Quinn's work, **69**, 75. Causes of his failure, **69**, 75. (See *Contracts.*)

**1868–69.** Readvertised October, 1868, **69**, 75. Contract with George W. Townsend, of Boston (January 26, 1869), at $40 per c. y. During season he removed 546⅓ c. y., **70**, 91, 33. Failed, **70**, 34. Application for extension of time refused, **70**, 91. (See *Contracts.*)

**1869–70.** 646⅓ c. y. removed to date, as per reports, **68**, 28, 91; **70**, 91. Survey of March, 1870, showed that but 470 c. y. had been removed, **70**, 91.

**1870–71.** Contract entered into with Richard Dunbar, of Washington, D. C., who failed to do anything, **71**, 31, 108. Operations abandoned to await result of work at Hell Gate, N. Y., **71**, 108; **73**, 137.

**1875.** Project approved for work by hired labor; plant purchased; drilling commenced from platform July 15; blasting began August 13; work suspended October 30, **76**, ii, 325, 327. Description of methods, **76**, ii, 323. Results and deductions therefrom, **76**, ii, 326.

**1876.** Operations recommenced June 6, **76**, ii, 330. Results and deductions, **77**, 846.

**1877.** Drilling and blasting renewed May 24. Dredging began June 26, and removed 3,000 c. y. of broken rock and 200 c. y. of bowlders. Total rock removed by dredging and by hoisting scow (to depth of 14 f. below low water of 1868, channel 130 f. wide) under last project, 3,350 c. y., or 5,964 c. y. s. m. Total expenditures under project to date, $42,940.13. Gross cost per yard in place, $12.82; s. m., $7.20. Net cost (excluding office expenses and market value of plant at close of work) per yard in place, $10.83; s. m., $6.08, **78**, 112, 1137, 1139. Range lights erected by United States Light-House Board, **78**, 1139.

**1879.** Three guiding cribs placed, one on east side and one on west side of the excavation. Sunk through ice;

## EAGLE HARBOR, MICH.—Continued.

works closed, **79**, 1480. List of materials used, **79**, 1481. Result of operations: A channel holding 14 f. for a width of 130 f., **79**, 1481.

**1880–81.** Stone filling put into guiding cribs, **81**, 272.

**1882–83.** Slight repairs made to guiding cribs, **83**, 275.

**1884–85.** Removal of bowlders from channel, **85**, 1970.

**1885–86.** Completion of removal of bowlders, **86**, 1644.

**1887–90.** Project completed and no further operations contemplated, **88**, 1821; **89**, 2020; **90**, 2299; **91**, 2505; **92**, 2142.

**1894–95.** Piers repaired, **95**, 2560.

**Physical characteristics.**

Of harbor, **66**, iv, 82; **68**, 89; **77**, 847.

Difference between water levels of 1865 and 1868 of 1 f., **68**, 93; of 1868 and 1876, **77**, 849.

General description, **76**, ii, 323.

Meteorological observations, **76**, ii, 329.

Length of season of navigation, 198 days, **77**, 850.

**Projects.** (See *Estimates.*)

History of, **74**, 135.

Original, by Maj. Raynolds, removal of rock on bar to 14 f. water, 260 f. by 130 f.; 1,803 c. y. of excavation, at $81, and 1,290 f. of crib pier 15 f. wide; estimate $191,189, **66**, iii, 9, iv, 83, 84; **67**, 256; **68**, 27; or to admit vessels drawing 14 f. (depth of channel 16 f.) would treble excavation, at additional expense of $292,032, **67**, 256.

Revised by Maj. Wheeler, for a breakwater with channel 130 f. wide and 14 f. deep (3,372 c. y., estimate, $195,588). For an 80-f. channel and breakwater, $184,024.72; for a channel 130 f. wide and breakwater, $237,321.12, **68**, 92. (Bacon's estimate, **68**, 90, 93.)

By Maj. Houston, for 120-f. channel, $215,000, **70**, 91.

By Maj. Farquhar, 1873, for a 130-f. channel and 20-f. breakwater, by hired labor, $248,000, **73**, 137.

Revised in 1874 (2,843 c. y. of rock work by hired labor, at $50 to complete) and a 30-f. breakwater, $231,570, + amount expended, $41,792.72 = $273,362.36, **74**, 35; **77**, 845.

By Maj. Robert, guiding cribs instead of breakwater, reducing total estimate $176,362, and at a total cost for the whole work of $97,000, **76**, ii, 328; **77**, 98, 845, 848. [Completed at cost of $93,000.]

The project for the improvement of this harbor was adopted in 1866, modified in 1868, 1874, and 1878, and completed in 1879, at a cost of $93,000. As finished it consisted in opening a channel 130 f. wide and 14 f. deep through the rocky reef obstructing the entrance to the harbor, and defining the entrance through the reef by a guiding crib on each side of the channel, **79**, 1480; **87**, 1970; **88**, 1821. Maj. Davis considered the work accomplished as fully satisfying the demands of commerce, **88**, 1821; **91**, 2505.

**Surveys.**

By United States Lake Survey in 1855, **66**, iv, 82. First project made on this survey.

By H. Bacon, through ice, January, 1868, **68**, 27, 89, 93.

By H. Bacon, December, 1868, **69**, 76.

By H. Bacon, March, 1870, **70**, 91.

By L. Y. Schermerhorn, February, 1876, **77**, 845.

MAPS AND SKETCHES. **76**, ii, 328; **78**, 1138.

## EAST BAY AND BLACKWATER RIVER FLA. (See *Blackwater* and *East Bay, Fla.*)

## EAST BAY BAYOU, TEX.

**Commerce.**

Yearly commerce, valued at about $5,000, farm products and mineral water, **1900**, 2380, 2383.

**Engineers.**

CHIEF OF ENGINEERS. Report, **1900**, 394.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–1900. Reports, **1900**, 2379, 2381.

ASSISTANT. S. M. Wilcox. Report, **1900**, 2383.

**Physical characteristics.**

East Bay Bayou empties into Galveston East Bay about 30 miles northeast of the city of Galveston, Tex., and is one of the adjacent streams referred to in the appropriation of March 3, 1899, for improving "Brazos River between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouth of adjacent streams," **1900**, 2380.

Description of, **1900**, 2383.

**Projects.**

Capt. Riché estimated, 1900, it would cost $10,000 to make the improvement as a part of an inland light-draft navigation system, **1900**, 2382.

**Surveys.**

Examination and survey ordered by act of March 3, 1899, made, 1899–1900, under direction of Capt. Riché (report favorable) (See *Projects*), **1900**, 2380, 2381.

## EAST BOSTON CHANNEL, MASS. (See *Boston Harbor, Mass.*).

**Commerce.**
Large and important, **93**, 794.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 53; **95**, 54.

ENGINEER IN CHARGE. Lt. Col. S. M. Mansfield, 1893–. Reports, **93**, 793; **95**, 649.

**Physical characteristics.**
Description of. At low water, 1899, the area almost entirely bare, **93**, 794.

**Projects.**
In 1894 Lt. Col. Mansfield estimated it would cost $60,000 to improve the channel, **95**, 649.

**Surveys.**
Examination from the southeasterly line of the Boston, Revere Beach & Lynn Railroad to the channel at Jeffries Point, ordered by act of July 13, 1892, made, 1892, by Lt. Col. Mansfield (report favorable), **93**, 793.

Survey ordered by act of Aug. 17, 1894, made by Lt. Col. Mansfield, 1894 (see *Projects*), **95**, 649.

## EAST CHESTER CREEK, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1873, | $25,000, | **73**, 85, 939; **74**, 95; **77**, 249. |
| 1875, | 12,000, | **75**, 102; **77**, 249. |
| 1878, | 10,000, | **78**, 56, 416. |
| 1879, | 3,500, | **79**, 63, 389. |
| 1880, | 3,500, | **80**, 513. |
| 1886, | 10,000, | **86**, 664. |
| 1888, | 5,000, | **88**, 576. |
| 1894, | 12,000, | **95**, 827. |
| 1896, | 10,000, | **96**, 732. |

Total, 91,000

**Commerce.**
In 1896 there was no commerce on the part of the stream mentioned by the act of 1896, **97**, 1175.

**Contracts.**
**1877.** John Saterlee, dredging, rock cutting, and building dikes, **77**, 249, 250.

**1883.** J. D. Flannery, dredging, 27 cents per c. y., **84**, 730.

**1887.** Frank Pidgeon Dredging Co., dredging, 26.9 cents per c. y., **87**, 630.

**1888.** Hartford Dredging Co., dredging, 45 cents per c. y., **88**, 576.

**1892.** Mt. Vernon Suburban Land Co., dredging, 22 cents per c. y., p. m., **93**, 967.

**1894.** J. McSpirit, dredging, 34 cents per c. y., and 12 cents per c. y., p. m. ($9,000), **95**, 828.

**1897.** J. McSpirit, dredging, 41 cents per c. y.; loose rock removal, $1.09 per c. y., and solid rock, $19 per c. y., p. m. ($8,070), **97**, 1092.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **71**, 83; **73**, 85; **74**, 95; **75**, 102; **76**, 56; **77**, 50; **78**, 56; **79**, 63; **80**, 83; **81**, 102; **82**, 103; **83**, 102; **84**, 107; **85**, 98; **86**, 91; **87**, 53; **88**, 55; **89**, 67; **90**, 60; **91**, 75, **92**, 79; **93**, 86; **94**, 77; **95**, 87; **96**, 84; **97**, 118, 140; **98**, 113; **99**, 128; **1900**, 145.

ENGINEERS IN CHARGE:

Lt. Col. John Newton, 1872–83. Reports, **72**, 812, 814; **73**, 939; **74**, ii, 166; **75**, ii, 221, **76**, 249; **78**, 416; **79**, 388; (Col.) **80**, 511; **81**, 640; **82**, 663.

Capt. James Mercur, in temporary charge, **77**, 223. Report, **77**, 249.

Lt. Col. G. L. Gillespie, 1883–86. Reports, **83**, 563; **84**, 728; **85**, 738.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 663; **87**, 628; (Col.) **88**, 577; **89**, 721; **90**, 656; **91**, 806; **92**, 708.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 965, **94**, 688; (Col.) **95**, 823.

Maj. H. M. Adams, 1896–98. Reports, **96**, 730; **97**, 1089, 1175; **98**, 997.

Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1215.

Maj. E. H. Ruffner, 1900–. Report, **1900**, 1387.

ASSISTANT. Capt. J. Mercur, **78**, 416.

**Legislation.**
Commissioners appointed by the State of New York to condemn and purchase necessary land, **74**, 95, ii, 166.

**Operations.**
**1872–76.** Operations delayed owing to difficulties in obtaining the right of way across certain lands, **73**, 85, 939; **74**, 95; **75**, 102, ii, 221; **76**, 249.

**1876–77.** 906 c. y. rock removed; 5,936 c. y. mud, etc., dredged, **77**, 249.

**1877–78.** 2,298 c. y. rock removed; 37,387 c. y. mud, etc., dredged; 1,235½ l. f. dike built, **78**, 416.

**1878–79.** 23,195 c. y. mud, etc., dredged; 85 stone removed, **79**, 63, 388.

**1883–84.** 18,236 c. y. dredged, **84**, 729.

**1886–87.** Preparations for dredging in vicinity of Town Dock; history of operations, **87**, 629.

**1887–88.** 1,772 c. y. dredged near Town Dock, **88**, 575.

**1888–89.** 11,067 c. y. dredged, **89**, 724.

## EAST CHESTER CREEK, N. Y.—Continued.

**1892–93.** 27,700 c. y. dredged, **93**, 967.

**1894–95.** 2,515 c. y., s. m., and 64,558 c. y., p. m., dredged, and some stones removed, **95**, 826.

**1895–96.** 5,467 c. y., p. m., dredged, **96**, 731.

**1897–98.** 12,960 c. y. dredged, 1,843 c. y. loose rock removed, and 66¼ c. y. rock removed, **98**, 997.

**1899–1900.** 3,937 c. y. dredged, project completed, **1900**, 1388.

**Physical characteristics.**

Description of, **72**, 812, 813; **88**, 574; **93**, 965; **97**, 1176.

A tidal stream with low, marshy banks on the north shore of Long Island and about 20 miles from the Battery, New York. Navigable for about 2¼ miles from its mouth. **97**, 1176.

**Plans.**

By Lt. Col. Newton, 1872, for a tidal reservoir, dredging, diking, and revetting for a 9-f. channel at m. l. w.; estimate, $1,646,000. For an 11-f. channel at m. h. w.; estimate, $731,000. For slack-water navigation, affording 7 f. draft, $300,000, **72**, 813.

**Projects.** (See *Plans.*)

By Col. Newton, 1872, for providing, by dredging and rock removal, a channel 9 f. deep at h. w. from Pelhams Bridge to a point 3,000 f. above Lockwoods, 3 miles, that part of channel above Lockwoods to serve as a channel and tidal basin. A modification of 1873 consisted of proposed timber dikes, 5,800 f. in length, to confine the channel; estimate, $136,500, **72**, 815; **73**, 939; **77**, 249; **86**, 663.

In 1887 the estimate of cost was raised to $221,100, **87**, 628.

In 1891 $55,000 was estimated as sufficient for completion of the improvement contemplated, **91**, 809; **92**, 708.

By Maj. Adams, 1896, for dredging out the shoals in the channel and for removing rock from below Lockwoods; and, should any money remain after completion of such work, extension of the channel of 100 f. width and 9 f. depth at m. h. w. toward head of tide water, provided the right of way for such extension could be obtained free of cost to the United States, the latter at an estimated cost of $27,000, **97**, 1091, 1177.

**Surveys.**

Under Lt. Col. Newton, **71**, 83, by J. H. Striedinger. Report, **72**, 812. Additional progress, **73**, 85.

Examination of channel depths, made, 1882, under direction of Col. Newton, **82**, 663.

Survey with a view to extension of improvement to head of tide water ordered by act of June 3, 1896, made by Maj. Adams, 1896 (report unfavorable), **97**, 1175.

MAPS. **86**, 664; **93**, 968.

## EAST DENNIS, BARNSTABLE BAY, MASS.[a]

**Appropriation.**

1852, $1,500.

## EASTERN BRANCH, ELIZABETH RIVER, VA. (See *Lynn Haven Bay*, *Norfolk Harbor*, and *Elizabeth River.*)

## EASTERN BRANCH, POTOMAC RIVER. (See *Anacostia River.*)

## EASTON POINT HARBOR, MD. (See also *Tread Haven Creek, Md.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 137.

ENGINEER IN CHARGE. W. F. Smith, U. S. Agent. Report, **85**, 890.

ASSISTANT. W. P. Smith. Report, **85**, 890.

**Physical characteristics.**

Improvement already made on Tread Haven Creek sufficient, **85**, 890.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of W. F. Smith, **85**, 890.

## EAST PASCAGOULA RIVER. (See *Pascagoula River, Miss.*)

## EAST POINT JUDITH, R. I. (See *Point Judith.*)

## EASTPORT, IOWA. (See *Missouri River between mouth and Sioux City.*)

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[a] Survey for breakwater—Report, Nov. 19, 1852; estimate, $500,000. (H. R. Doc. No. 482, 55th Cong., 2d sess., 1898.)

## EASTPORT, MICH. (See *Grand Traverse Bay, Mich.*)

## EAST RIVER, N. Y., including Hell Gate, Battery Diamond and Coenties Reefs. (See *New York Harbor, N. Y.*)

**Appropriations.**

| | | |
|---|---|---|
| 1852, | [a]$20,000, | **66**, iii, 29. |
| 1868, | 85,000 (allotment), | **68**, 66; **69**, 55, 388. |
| 1869, | 178,200 (allotment), | **69**, 55; **70**, 435. |
| 1870, | [b]250,000, | **70**, 74, 435. |
| 1871, | [b]250,000, | **71**, 82; **77**, 230. |
| 1872, | [b]225,000, | **72**, 80; **77**, 230. |
| 1873, | [b]225,000, | **73**, 85; **77**, 230. |
| 1874, | [b]225,000, | **74**, 95; ii, 165. |
| 1875, | [b]250,000, | **75**, 101, ii, 203. |
| 1876, | [b]250,000, | **76**, 55; **78**, 413. |
| 1878, | [b]350,000, | **78**, 55, 413. |
| 1879, | [b]250,000, | **79**, 62, 376. |
| 1880, | 200,000, | **80**, 499. |
| 1881, | 200,000, | **81**, 624. |
| 1882, | 250,000, | **82**, 649. |
| 1884, | 360,000, | **84**, 692. |
| 1886, | 112,500, | **86**, 678. |
| 1888, | 250,000, | **88**, 606. |
| 1890, | 200,000, | **90**, 719. |
| 1892, | 150,000, | **92**, 805. |
| 1894, | 75,000, | **95**, 934. |
| 1896, | 60,000, | **96**, 858. |
| 1899, | 250,000, | **99**, 1231. |
| Total, | 4,665,700 | |

**Commerce.**

Danger and difficulty in passing Hell Gate, **68**, 730, 731.

Amount of commerce benefited by improvement, **77**, 230.

At 1897 the increasing draft and tonnage of vessels indicated that a revision of the ruling depths even in improved parts of the stream was needful, **97**, 1028.

Description of, **1900**, 1437.

**Contracts.**

**1869.** J. D. Shelbourne, removing Frying Pan and Pot Rock; unsatisfactory progress made, **69**, 55, 388. Contract expired by limitation, with no work done, **70**, 74, 434, 438. Maillefert & Co., removal of Pot Rock, Ways Reef, and Shelldrake Rock, **69**, 55, 388. Contract expired by limitation, with small amount of work done, **70**, 434, 439.

**1876.** E. R. Seward, removal of 24,000 tons broken rock, Hallets Point, **77**, 49, 227. Extended and completed, **78**, 55, 413.

**1878.** Atlantic Dredging Co., removing 25,000 tons of broken rock, Hallets Point, **78**, 55, 413. Completed, **79**, 61.

**1879.** Atlantic Dredging Co., removing 25,000 tons broken rock, Hallets Point, **79**, 61, 377.

**1885.** Rendrock Powder Co., copper cartridge cases, 225,000 pounds rackarock, **84**, 719. R. W. Warren, 50,000 pounds dynamite, **85**, 719. Atlantic Dredging Co., rock removal, Flood Rock, $3.19 per ton, **86**, 678.

**1890.** R. G. Packard, removal of material other than bowlders, 85 cents per c. y.; bowlders, $2.50 per ton, **91**, 902.

**1894.** P. Ward, repair of dredge *Hell Gate*, $15,800, **95**, 935.

**1899.** R. G. Packard, removing Man-o'-War Rock, $159,000, **99**, 1232.

**Documents.** (Not published in reports.)

H. Doc. 90, 39th Cong., 2d sess.. **67**, 17, 44; **68**, 733.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7, ii, 41, iii, 29; **67**, 17, 44; **68**, 65, 726, 729, 742; **69**, 55; **70**, 73; **71**, 82; **72**, 79; **73**, 84; **74**, 94; **75**, 100; **76**, 54; **77**, 49, 231; **78**, 55; **79**, 61; **80**, 81; **81**, 98; **82**, 99; **83**, 94; **84**, 100; **85**, 96; **86**, 95; **87**, 59; **88**, 60; **89**, 75; **90**, 66; **91**, 86; **92**, 90; **93**, 97; **94**, 87; **95**, 100; **96**, 106; **97**, 111; **98**, 126; **99**, 134, 142; **1900**, 152, 160.

BOARD OF ENGINEERS. 1856. (Advisory Council to New York Harbor Commission.) Recommend the removal of Pot Rock, Frying Pan, Ways Reef, and a part of Hallets Point, with other minor rocks; the closing of small channel between Bread and Cheese and head of Blackwell Island; the construction of stone piers on Hogs Back, Gridiron, and Bread and Cheese, and a beacon on Rylanders Reef, **68**, 65, 733. (Col. Totten, Chief of Engineers; Supt. Bache, U. S. C. S.; Commander Davis, U. S. N.)

ENGINEERS IN CHARGE:

E. Merrian, 1851–53; **68**, 732, 733.

Maj. W. D. Fraser, 1853–54; **68**, 727, 732.

Lt. Col. J. Newton, 1866–85. Reports, **68**, 727, 730, 742; **69**, 388, 390, 391; **70**, 433; **71**, 723; **72**, 802; **73**, 934; **74**, ii, 160; **75**, ii, 200; **76**, 238; **77**, 227, 231, 232; **78**, 412; (Col.), **79**, 375; **80**, 496; **81**, 621; **82**, 649; **83**, 533; **84**, 689; **85**, 715; **86**, 680.

Capt. J. Mercur, temporarily in charge, 1877; **77**, 48, 227.

Lt. Col. W. McFarland, 1885–89. Reports, **86**, 675; **87**, 689; **88**, 603.

Lt. Col. G. L. Gillespie, 1889–96. Reports, **89**, 772; **90**, 713; **91**, 899; **92**, 797; **93**, 1034; **94**, 751; **95**, 930; (Col.), **96**, 853.

Lt. Col. W. Ludlow, 1897. Report, **97**, 1026.

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[a] Hell Gate.

[b] East River and Hell Gate.

## EAST RIVER, N. Y., including Hell Gate, Battery Diamond and Coenties Reefs—Continued.

Maj. H. M. Adams, 1898–1900. Reports, **98**, 1036; **1900**, 1436.

Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1229.

Maj. E. H. Ruffner, 1900. Report, **1900**, 1403.

Maj. W. L. Marshall, 1900. Report, **1900**, 1439.

ASSISTANTS. (See also *Surveys.*)

Lt. Bartlett, **68**, 732.

W. Preuss, **72**, 803; **77**, 238.

F. Sylvester, **72**, 803.

Lt. W. H. Heuer, **73**, 936; **77**, 227. Reports, **75**, ii, 203; **76**, 238.

Capt. J. Mercur, **77**, 227, 237; **79**, 60. Reports, **79**, 375, 377; **80**, 499; **84**, 692.

J. H. Striedinger, **74**, ii, 164; **77**, 236. Reports, **75**, ii, 208; **76**, 239; **77**, 227.

B. Boyle, **77**, 238.

A. Doerflinger, **77**, 238.

M. A. Lacy, **77**, 238.

R. Stone, **79**, 375. Reports, **79**, 382; **80**, 503; **81**, 627; **82**, 653.

Lt. G. McC. Derby. Reports, **82**, 651; **83**, 536; **85**, 720, 724, 734.

**Estimates.** (See *Plans* and *Projects.*)

Maj. Fraser, 1853, for the removal of rocks in Hell Gate, at $1.14 per c. f., **68**, 733, 738.

Lt. Col. Newton, 1867, for removal of rock at Hell Gate (see *Plans* and *Projects*): 1st plan, to a depth of 25 f., $5,008,580, or to depth of 26 f., $5,723,129, **68**, 738, 741; **70**, 437; 2d plan, to a depth of 25 f., $7,737,974, or to a depth of 26 f., $8,692,645, **68**, 741; **70**, 437; **74**, ii, 164; 3d plan, to a depth of 25 f., $2,674,930, or to a depth of 26 f., $2,877,000, **68**, 730, 741; **70**, 438.

Lt. Col. Newton, 1870, revised estimate, from experience gained: 1st plan, to depth of 25 f., $3,000,000; 2d plan, to depth of 25 f., $4,100,000; 3d plan, to depth of 25 f., $2,070,000, **70**, 438.

Lt. Col. Newton, 1874, revising previous 2d plan, to depth of 26 f., $4,689,820, **74**, ii, 164; **75**, ii, 202; **76**, 243.

Lt. Col. Newton, 1868, for removing reefs at mouth of East River: Battery Reef to depth of 24 f., $14,245; Diamond Reef to depth of 22½ f., $185,125; Diamond Reef to depth of 24 f., $309,400; Coenties Reef to depth of 22½ f., $100,000, or to depth of 24 f., $139,000, **68**, 66, 745; **74**, ii, 164; **76**, 243.

**1879.** For completion of existing project, $2,615,078, **79**, 376.

**Legislation.** (See *Obstructions.*)

Act by New York legislature incorporating the East River Bridge Co., **92**, 805.

Act amending act incorporating a company to erect a bridge across the river between New York and Long Island, **93**, 1041.

Act, dated May 27, 1895, passed and accepted by the city of New York, for construction of a bridge across the river between New York City and Brooklyn, **96**, 859.

**Obstructions.**

Bridges affected by Congressional or State acts, **95**, 933; **96**, 856; **97**, 1030.

**Operations.**

**1851–52.** Efforts to remove rocks in Hell Gate by surface blasts, **68**, 732.

**1869–70.** Work began under project of Lt. Col. Newton; 1,621 c. y. rock removed from Ways Reef and 220 c. y. from Shelldrake rock; unsatisfactory results from contracts; completion by hired labor of cofferdam at Hallets Point and removal of 4,841 c. y. rock from shaft; also construction of drilling scow for the removal of channel rocks. Valuable experience gained by operations, **70**, 73, 434, 437, 439, 440.

**1870–71.** Completion by hired labor of shaft at Hallets Point, and 709 l. f. tunnels, with 182 l. f. galleries, removing 8,306 c. y. rock, **71**, 82, 727. Operations of steam drilling scow by hired labor at Diamond and Coenties reefs, **71**, 725.

**1871–72.** Construction at Hallets Point by hired labor of 1,653 l. f. tunnels and 653¾ l. f. galleries, removing 8,293 c. y. rock. The removal of 6,119 c. y. rock from Diamond and Coenties reefs by aid of steam drilling scow. Commencement of operations by drilling scow at Frying Pan Rock. Success of drilling scow. **72**, 80, 803, 805.

**1872–73.** At Hallets Point, 2,731 l. f. tunnels and galleries driven, removing 9,554 c. y. rock, **73**, 84, 934. 211 c. y. rocks dredged from Diamond Reef; operations of drilling scow on Frying Pan and Pot Rock; results from drilling experience, **73**, 84, 935, 937.

**1873–74.** At Hallets Point 896 l. f. tunnels and galleries driven, removing 4,648 c. y. rock; at Coenties Reef 2,805 c. y. rock removed, **74**, 94; ii, 160.

**1874–75.** Completion of tunnels and galleries at Hallets Point by driving 645 l. f., removing 13,838 c. y. rock. Removal of 3,029 c. y. rock from Ways Reef, completing work thereat; 654 c. y. from Coenties Reef and 413 c. y. from Diamond Reef. Shaft on Flood Rock began. Removal by dredging of 1,260 c. y. from piers and abutments of old bridge (114th street), Harlem River. **75**, 101, ii, 204.

**1875–76.** At Hallets Point, drilling roof and piers for final blast. At Flood Rock two shafts sunk to depth of 51 and 32 f., removing 1,462 c. y. rock. **76**, 54,

**EAST RIVER, N. Y., including Hell Gate, Battery Diamond and Coenties Reefs**—Continued.

238. Operations of drilling scow. Completion of the removal of Coenties Reef to a low-water depth of 25½ f. At Diamond Reef 972 c. y. rock removed. **76**, 54, 239.

**1876–77.** At Hallets Point completion of mining operation and successful explosion of mine September 24, 1876. Removal by contract of 14,055 tons broken rock. At Flood Rock 1,772 c. y. rock removed. Operations of drilling scow; 916 c. y. rock removed from Diamond Reef; small amount of work done for lack of appropriations. **77**, 49, 227, 231.

**1877-78.** At Hallets Point 23,258 tons broken rock removed by contract.

**1878–79.** At Hallets Point 19,706 tons rock removed by contract. At Flood Rock (work having been suspended since January, 1876) 1,307 l. f. galleries driven, removing 5,115 c. y. rock. Ways Reef removed to a depth of 26 f. Coenties Reef removed to a depth of 25½ f. Operations of the steam drilling scow. Drilling at Diamond Reef, Shelldrake, and Frying Pan rocks. Removal of 519 c. y. from Diamond Reef, **79**, 61, 62, 377, 378.

**1879–80.** At Hallets Point 15,195 tons of broken rock removed by contract. At Flood Rock 4,346 l. f. galleries driven, removing 12,941 c. y. rock; removal of small rock near North Brothers Island; Diamond Reef removed to a depth of 26 f.; 2,596 c. y. rock and bowlders removed from Frying Pan, Shelldrake, and Diamond reefs. **80**, 496–505.

**1880–81.** At Hallets Point 9,824 tons of broken rock removed by contract. At Flood Rock 7,312 l. f. galleries driven, removing 18,080 c. y. rock; 1,096 c. y. rock removed from Heel Tap and North Brothers Reef. **81**, 621–628.

**1881–82.** At Hallets Point 8,549 tons of broken rock removed by contract. At Flood Rock 6,453 l. f. galleries driven, removing 21,690 c. y. rock; 2,112 c. y. rock removed from Heel Tap and North Brothers Reef. **82**, 646–654.

**1882–83.** Completion of rock removal at Hallets Point. At Flood Rock 204 l. f. galleries driven, removing 14,206 c. y. rock; 666 c. y. rock removed from Pot Rock and Frying Pan, **83**, 533–542.

**1884–85.** At Flood Rock 1,488 l. f. galleries driven, removing 9,819 c. y. rock, and completing all work preparatory to charging and exploding the mine, **85**, 715–722. Removal of Pilgrim Rock to a depth of 24 f., **85**, 734. Experiments with explosives made, **85**, 724.

**1885–86.** Mine under Flood Rock fired October 10, 1885, **86**, 675, 688. Details of charging and explosion, **86**, 680. 558 tons of rock removed from channel at Negro Heads and Hen and Chickens; 28,622 tons of rock removed from Flood Rock by contract, **86**, 676, 679, 688. Summary of work done from 1875 to 1886, **86**, 690.

**1886–87.** 34,956 c. y. rock removed in widening Newton Channel and in cutting away the northern end of Flood Rock, **87**, 59, 691, 694. Details of cost of rock removal, **87**, 691, 692.

**1887–88.** 19,548 tons rock removed, **88**, 605.

**1888–89.** 1,410 tons rock removed by hired labor, **89**, 775.

**1889–90.** 47,398 tons rock removed, **90**, 716.

**1890–91.** Removal of rock at Flood Rock and Diamond Reef; 3,435 c. y. and 960 tons of bowlders removed from Shell Reef; 24,040 tons rock removed from reef off Diamond Reef, **91**, 902, 904.

**1891–92.** 20,872 tons rock blasted and removed at Flood Rock; 52,803 c. y. dredged and 2,800 tons rock removed at Shell Reef and Middle Ground; 1,763 tons rock removed at Ferry Reef; 1,211 tons rock removed from reef off Diamond Reef, **92**, 800, 803.

**1892–93.** 21,126 tons rock removed from Flood Rock; 48,853 c. y. fine material dredged from, and 313 tons bowlders removed from Sheel Reef; 668 tons rock removed from Ferry Reef, 1,382 from Baretto Point, and 764 from Sunken Meadow, **93**, 1038, 1039, 1040.

**1893–94.** 5,513 tons rock removed from Flood Rock, and 6,833 from Sunken Meadow, **94**, 754, 755.

**1894–95.** 681 tons rock removed from Sunken Meadow, **95**, 933.

**1895–96.** 4,673 tons rock removed from Sunken Meadow, **96**, 857.

**1896–97.** 2,175 tons rock removed from Sunken Meadow; 7,485 from Charlotte Rock, and 33,148 c. y. dredged from approaches to Davids Island and Willets Point, **97**, 1029.

**1897–98.** 31 tons rock removed from Sunken Meadow, **98**, 1037.

**1899–1900.** Removal of Man-o'-War Rock in progress, and 39 tons rock removed from Middle Reef, **1900**, 1404.

**Physical characteristics.**

Formation of Battery Reef, **68**, 742. Area covered by, **68**, 744.

Area covered by Hell Gate Reefs, **68**, 739.

Formation of rock at Hallet's Point, **71**, 724. Leakage in tunnels at, **71**, 725.

Velocity of currents at Hell Gate, **68**, 736; **72**, 805; **75**, ii, 208.

Tides, rise and fall of, **75**, ii, 208.

Physical effect of Hallet's Point blast, **77**, 233.

Observations on transmission of earth

## EAST RIVER, N. Y., including Hell Gate, Battery Diamond and Coenties Reefs—Continued.

waves at explosion of Flood Rock, **86**, 691–717.

Description of obstructions at Hell Gate, **88**, 603.

Description of Diamond Reef and Coenties Reef, **1900**, 1436.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Davis, U. S. N., 1848, for removal of Pot Rock, Frying Pan, and Ways Reef, with the removal of rocks from the middle channed, i. e., Little Mill and Flood Rock, and the construction of fender piers on Hog's Back, Gridiron, and Bread and Cheese rocks, **68**, 731.

By Lt. Porter, U. S. N., 1848, favors the above except the removal of rocks in middle channel, and suggesting that they be covered with fender docks; also the removal of a part of Hallet's Point and various small rocks below, **68**, 731.

By M. Maillefert, 1851–53, for the removal of rock in Hell Gate by surface blasts, **68**, 732, 733.

By advisory Board, 1856. (See *Board of Engineers.*)

By Lt. Col. Newton, 1867, for the improvement of navigation through Hell Gate by three plans, to wit: 1st, by the removal to a m. l. w. depth of 25 to 26 f. Pot Rock, Frying Pan, Way's Reef, Shelldrake, and Heeltap, with rocks off Negro Point, Scaly Rock, and Hallet's Point; with sea walls on Hen and Chickens, Flood Rock, Gridiron, and Hog Back, Holmes Rock, Great and Little Mill Rock, Bread and Cheese, and Rylander's Reef. Time required for completion, six years, at estimated cost for channel, 25 f., $5,008,580; for 26 f. channel, $5,723,129, **68**, 738, 741. Revised, 1870, to $4,100,000, **70**, 438. 2d (see *Projects*). 3d, by the removal of Pot Rock, Frying Pan, Way's Reef, Shelldrake, Heeltap, Scaly Rock, and part of Hallet's Point, with sea walls along Hen and Chickens, Flood Rock, and Gridiron, at estimated cost, to a depth of 25 f., $2,674,930; to a depth of 26 f., $2,877,000, **68**, 65, 730. This plan recommended by Chief of Engineers for commencement of work, but subsequently became expanded to second plan (see *Projects*), **68**, 730; **70**, 438; **72**, 803; **75**, ii, 202.

Plan for passing obstruction at Hell Gate by canal through Astoria, 1870. The project for the removal of rock in channels, reported preferable, **70**, 436.

**Private (city) work.**

**1861-63.** Partial removal of Coenties Reef by New York City, **68**, 744.

**1870.** Construction of sea wall at head of Blackwell's Island by commissioners of public charities, **70**, 437.

**Projects.** (See *Estimates* and *Plans.*)

In 1851–52, under an appropriation of $20,000, an effort was made to improve navigation through Hell Gate by the removal of rock through the aid of surface blasting, **68**, 732. The project for the improvement of Hell Gate was proposed by Col. Newton in 1867. It was subsequently modified, in 1868, 1874, 1880, and 1884, by extending it to embrace the removal of other reefs in the East River. Later it included the removal to a depth of 26 f. at m. l. w. of all the dangerous reefs in Hell Gate, Diamond Reef, and North Brothers Island Reef, in the East River, the removal of Coenties Reef to 25½ f., and a number of small rocks in the shoaler parts of the channels; also, the construction of sea walls on Great and Little rocks, Hog's Back, and Holmes Rock; estimate, $5,139,120. **68**, 741–745; **70**, 437; **71**, 725; **72**, 803; **74**, ii, 164; **76**, 243; **80**, 497; **84**, 690; **86**, 95.

By Lt. Col. Gillespie, 1895, for expenditure of appropriation of 1894 in continuation of work on Sunken Meadow and for repair of plant, **95**, 933.

By Lt. Col. Ludlow, 1896, for expenditure of appropriation of 1894 in continuation of work on Sunken Meadow, etc., and for increasing facilities and depth in approaches at Davids Island and Willets Point, **97**, 1029.

Description of work done up to 1898, showing original, existing, and projected depths, **98**, 1037.

By Lt. Col. Benyaurd, 1899, for survey and removal of Man-o'-War Rock to depth of 26 f. m. l. w.; estimate, $500,000, **99**, 1229.

By Maj. Ruffner, 1900, for removal of reef off Twenty-sixth street to depth of 26 f. m. l. w., and reef off Third street to depth of 19 f. m. l. w., **1900**, 1404.

Maj. Marshall, 1900, estimated it would cost $1,897,500 to remove Diamond and Coenties reefs to depth of 32 f. m. l. w., **1900**, 1440.

**Surveys.**

AT HELL GATE:

By Lt. Davis, U. S. N., 1848; **68**, 730.

By Maj. Fraser, 1853; **68**, 733.

By Lt. Craven, 1856; **68**, 729, 734.

By Lt. Col. Newton, 1866–79; **66**, iii, 29; **67**, 41; **69**, 55, 389; **72**, 803; **78**, 55.

By Lt. Col. Newton, 1867, of Diamond, Battery, and Coenties reefs, **68**, 742, 745.

Survey of Man-o'-War Rock made, 1889, by Lt. Col. Benyaurd, **99**, 1230.

Examination of Middle Reef made, 1899, by Maj. Ruffner, **1900**, 1404.

Examination of Diamond Reef and Coenties Reef, ordered by act of Mar. 3,

## EAST RIVER, N. Y., including Hell Gate, Battery Diamond and Coenties Reefs—Continued.

1899, made, 1899, by Maj. Adams (report favorable), **1900**, 1436.

Survey of Diamond Reef and Coenties Reef, ordered by act of Mar. 3, 1899, made, 1899, by Lt. Col. Benyaurd (report rendered by Maj. Marshall) (report favorable; see *Projects*), **1900**, 1439.

MAPS:

Sketch of plan of shaft and tunnels at Hallett's Point, **72**, 803; **73**, 936; **74**, ii, 163; **75**, ii, 201.

Sketch showing Way's Reef, **75**, ii, 210.

Hell Gate and vicinity, **79**, 376.

Progress sketch of Flood Rock, showing condition of the excavation, **79**, 378; **80**, 496; **81**, 622; **82**, 646; **83**, 533; **85**, 735.

Hell Gate and approaches, **85**, 735; **86**, 688.

Flood Rock, **86**, 688.

## EAST RIVER, N. Y., Broome, Twenty-third, Tenth, Eleventh streets, New York, N. Y.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 67; **89**, 83; **90**, 74; **91**, 86, 425.

ENGINEERS IN CHARGE:

Lt. Col. W. McFarland. Report, **87**, 758.

Lt. Col. G. L. Gillespie, 1888. Reports, **90**, 761; **91**, 899.

ASSISTANT. G. W. Kuehule. Report, **90**, 765.

**Physical characteristics.**

Least depth over ledge, Tenth and Eleventh streets, 10 f., **87**, 758.

**Plans.**

By Lt. Col. Gillespie, 1890, for rock removal and dredging so as to obtain an 18-f. channel between Broome and Twenty-third streets in the East River; estimate, $267,996, **90**, 764.

**Surveys.**

Survey from the foot of Broome street to the foot of Twenty-third street, New York City, ordered by act of Aug. 11, 1888, made, 1890, under direction of Lt. Col. Gillespie, **90**, 761.

Examination of ledge of rock, foot of Tenth and Eleventh streets, New York City, ordered by act Aug. 5, 1886, made in 1887 by Lt. Col. W. McFarland (report favorable but "cost too great"), **87**, 758.

## EAST ROCKAWAY CREEK, N. Y.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 93.

ENGINEER IN CHARGE. Capt. T. L. Casey, 1888. Report, **89**, 840.

**Physical characteristics.**

Description of, **89**, 841.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Capt. McC. Derby (report unfavorable), **89**, 840.

## EAST THOMASTON HARBOR, ME.[a] (See also *Georges* and *St. Georges rivers.*)

## ECHO HARBOR, N. Y. (See *New Rochelle Harbor, N. Y.; Echo Harbor* and *New Rochelle, N. Y.*)

**Appropriations.**

| | | |
|---|---|---|
| 1878, | $10,000, | **78**, 57, 720. |
| 1879, | 3,000, | **79**, 63, 390. |
| 1880, | 3,000, | **80**, 514. |
| 1881, | 3,000, | **81**, 642. |
| 1882, | 3,000, | **82**, 665. |
| Total, | 22,000 | |

**Contracts.**

**1878.** Thomas A. Scott, removing Start Rock to 7 f., $6,125, **79**, 390.

**1881.** G. W. Townsend, removing part of Sheepshead Reef, **82**, 666.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 57; **78**, 57; **79**, 63; **80**, 83; **81**, 103; **82**, 104; **83**, 97; **84**, 104; **85**, 89; **86**, 89; **87**, 52; **88**, 54; **89**, 66; **90**, 60; **91**, 74; **92**, 79.

ENGINEERS IN CHARGE:

Lt. Col. John Newton, 1875–84. Reports, **76**, 263; **78**, 420; **79**, 389; (Col.), **80**, 513; **81**, 641; **82**, 664; **83**, 545.

Capt. J. Mercur, 1884–85. Report, **84**, 708.

Lt. Col. W. McFarland, 1885–86. Report, **85**, 661.

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[a] Survey—Report Nov. 30, 1885, estimate, $1,000,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## ECHO HARBOR, N. Y.—Continued.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 655; **87**, 624; (Col.), **88**, 570; **89**, 717; **90**, 652; **91**, 804; **92**, 706.

ASSISTANTS:
J. H. Striedinger, **76**, 265.
A. Doerflinger, **76**, 264.

**Estimates.** (See *Projects.*)
By Lt. Col. Newton, removal of Sheep's Head Rock and Start Rocks, $38,955.38. For the removal of Long Rock, $37,696 additional, **76**, 265. To complete existing project, $25,955.38, **79**, 390.

**Operations.**
**1878–79.** Removal of Start Rock, **79**, 63, 389.
**1879–80.** Removal of Start Rock completed, **80**, 513.
**1881–82.** 506 c. y. rock removed from Sheepshead Reef, **82**, 665.
**1889–90.** 9,122 c. y. dredged from the channel by hired labor, **90**, 653.

**Physical characteristics.**
Description of, **76**, 263–265; **88**, 570.

**Projects.** (See *Estimates.*)
By Col. Newton, 1875, for removal of Sheepshead Reef and Start Rock to a depth of 9 and 6 f. respectively. Modified, 1878, removal of Start Rock to 7-f. depth; estimate, $38,955.38. **76**, 264; **86**, 656; **87**, 624; **92**, 706.

**Surveys.**
By J. H. Striedinger and A. Doerflinger, under direction of Lt. Col. Newton. Report, **76**, 263.
MAPS. **80**, 513.

## ECHO HARBOR AND NEW ROCHELLE, N. Y. (See *Echo Harbor; New Rochelle Harbor, N. Y.*)

**Commerce.**
Consists of about one steamboat a day from New York, **95**, 870.
Description of, **1900**, 1425, 1426, 1428, 1430.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **95**, 94; **99**, 142; **1900**, 160.

ENGINEERS IN CHARGE:
Lt. Col. H. M. Robert, 1894–95. Report, **95**, 868.
Lt. Col. W. H. H. Benyaurd, 1900. Report, **1900**, 1423, 1429.

ASSISTANT. Lt. W. E. Craighill. Report, **95**, 869.

**Physical characteristics.**
Description of, **95**, 869; **1900**, 1424, 1425.

**Projects.**
Lt. Col. Benyaurd estimated, 1899, it would probably cost $17,000 to complete work suspended at Echo Bay, New Rochelle, in 1893; the removal of Start Rock to 7-f. depth, and of Sheepshead Reef to 9-f. depth, **1900**, 1429.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made, 1894, under direction of Lt. Col. Robert (report unfavorable), **95**, 868.
Examination and survey New Rochelle Harbor (report unfavorable) and Echo Bay, N. Y. (limited improvement recommended), ordered by act of Mar. 3, 1899, made, 1899, by Lt. Col. Benyaurd, **1900**, 1424, 1429.
Secretary of War, 1899, called for plan and estimate of improving Echo Bay. Submitted, 1899, by Lt. Col. Benyaurd (see *Projects*), **1900**, 1429.

## EDENTON HARBOR, N. C.

**Appropriations.**

| | | |
|---|---|---|
| 1878, | $4,000, | **78**, 175; **79**, 696. |
| 1879, | 1,000, | **79**, 92, 696. |
| 1884, | 10,000, | **84**, 1036. |
| 1886, | 2,000, | **86**, 964. |
| Total, | 17,000 | |

**Commerce.**
Requirements, **76**, 359.

**Contracts.**
**1878.** G. H. Ferris, dredging, 15 cents per c. y., **79**, 697.
**1885.** T. P. Morgan, dredging, 14 cents per c. y., **85**, 1039.
**1899.** J. Caller, dredging, 21 cents per c. y. ($2,000), **1900**, 1781.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **73**, 79; **76**, 68; **78**, 175; **79**, 91; **80**, 121; **84**, 168, 177, 1074; **85**, 159; **86**, 154; **87**, 122; **99**, 230; **1900**, 263.

ENGINEERS IN CHARGE:
Maj. W. P. Craighill, 1872. Report, **73**, 854.
S. T. Abert, U. S. C. E., 1875. Report, **76**, 358.
Capt. C. B. Phillips, 1879–80. Reports, **79**, 696; **80**, 830.
Capt. F. A. Hinman, 1884–87. Reports, **84**, 1035, 1071; **85**, 1038; **86**, 963; **87**, 989.
Col. W. P. Craighill, 1888. Report, **88**, 773.

## EDENTON HARBOR, N. C.—Continued.

Maj. T. L. Casey, 1899. Report, **99**, 1482.

Maj. J. B. Quinn, 1900. Report, **1900**, 1780.

Assistant. G. H. Elliott. Reports, **73**, 856; **79**, 697; **84**, 1074.

**Estimates.** (See *Projects.*)

By G. H. Elliott, 1872, for dredging channel, 100 f. by 9 f., from the wharves to deep water in the bay, $10,000, **73**, 855, 857.

By S. T. Abert, 1875, for dredging channel, 2,500 f. to 2,600 f. by 100 f. by 9 f., and deepening the approach to the wharves, $12,650, **76**, 360.

**Operations.**

**1878–79.** Channel 850 y. long, 100 f. wide, and 9 f. deep, dredged; 21,360 c. y. removed; dredging a turning basin begun, **79**, 91, 696, 697.

**1879–80.** 3,260 c. y. dredged and 5 cypress stumps removed, **80**, 830.

**1884–85.** 29,000 c. y. dredged from channel and basin, **85**, 1039.

**1885–86.** 17,043 c. y. dredged from channel and basin, **86**, 963.

**1899–1900.** 10,005 c. y. dredged, **1900**, 1780.

**Physical characteristics.**

Description, **76**, 358, 359; **78**, 857.

**Projects.** (See *Estimates.*)

By S. T. Abert, 1875, for improvement of Edenton Harbor and Bay by excavation of channel 850 y. long, 100 f. wide, and 9 f. deep; also a turning basin at the wharves; estimated cost, $12,650, **79**, 91, 696; **80**, 121.

From 1878–84 $5,000 was appropriated and expended upon this project.

In 1883 Capt. Mercur proposed widening the channel to 150 f. at the outer and 200 f. at the inner end; also the completion of the turning basin with an area of about 12 acres; estimate, $18,000, **84**, 1073, 1074; **87**, 122.

In 1888 Col. Craighill recommended no further appropriations, the harbor being amply sufficient for commercial requirements, **88**, 774.

Authority of the Chief of Engineers was obtained, 1899, for completing project under which operations were previously carried on, by dredging from Town Wharf to the first beacon outward, **99**, 1482.

**Surveys.**

Under direction of Maj. Craighill, by George H. Elliott, 1872. Report, **73**, 854, 856.

By S. T. Abert, 1875. Report, **76**, 358.

Ordered by act of Aug. 2, 1882, made, 1883, under direction of Capt. Mercur, **84**, 1072.

Maps. **86**, 964.

## EDGARTOWN HARBOR, MASS.[a] (See *Marthas Vineyard, Mass.*)

## EDINBURGH. (See *Pearl River, Miss.*)

## EDISTO RIVER, S. C. (See *South Edisto River.*)

| Part. | Appropriations. |
|---|---|
| A.—Edisto River | $33,385 |
| B.—North Fork | ...... |
| C.—North and South forks | ...... |

### Part A.—Edisto River, S. C.

**Appropriations.**

1882, $8,000, **83**, 889.
1884, 5,000, **84**, 1094.
1886, 3,000, **86**, 1084.
1888, 5,000, **88**, 987.
1890, 5,000, **90**, 1208.
1892, 7,385, **92**, 1234.

Total, 33,385

In 1895–96 the money remaining, $282.35, was turned into the Treasury, it being apparent that no further improvement of the river was advisable, **96**, 1207.

**Commerce.**

Commercial prospects of the river, **88**, 986. Prospective development of timber interests, **89**, 1169.

In 1892–93 the freight carried on the river amounted to 129,125 tons, **93**, 1518; in 1893–94, to 120,870 tons, **94**, 1120; in 1894–95, to 177,000 tons, **95**, 1438.

**Engineers.**

Chief of Engineers. Reports, **80**, 132; **81**, 179; **83**, 174; **84**, 180; **85**, 181, 191; **86**, 179; **87**, 143, 154; **88**, 136; **89**, 152; **90**, 136; **91**, 177; **92**, 174; **93**, 189; **94**, 173; **95**, 197; **96**, 176.

Engineers in Charge:

Col. Q. A. Gillmore, 1880–87. Reports, **81**, 1138; **83**, 887; **84**, 1092; **85**, 1190; **86**, 1082; **87**, 1143.

Capt. F. V. Abbot, 1888–96. Reports, **88**, 985; **89**, 1169, 2795; **90**, 1206; **91**,

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[a] Survey.—Report, 1826; estimate, $4,273.56. (H. Doc. No. 482, 55th Cong., 2d sess.)

## EDISTO RIVER, S. C.—Continued.

### Part A.—Edisto River, S. C.—Continued.

1480; **92**, 1233; **93**, 1517; **94**, 1119; **95**, 1438; **96**, 1207.

ASSISTANTS:

Capt. J. C. Post. Report, **81**, 1140.

Capt. T. M. Bailey. Reports, **83**, 889; **84**, 1094.

Lt. F. V. Abbot. Reports, **85**, 1192; **87**, 1145.

J. P. Allen. Reports, **89**, 1170; **90**, 1208; **91**, 1481; **92**, 1234; **93**, 1519.

**Obstructions.**

Bridges obstructing navigation, **89**, 2795.

Efforts were made in 1893 to obtain evidence against persons in the habit of throwing tops of trees into the river, **93**, 1521.

**Operations.**

**1882–83.** 77 snags, 124 piles, and 248 overhanging trees removed, **83**, 888.

**1883–84.** 40 piles, 57 snags, and 101 overhanging trees removed, **84**, 1093.

**1884–85.** 5,798 overhanging trees cut down, 4,942 snags removed, and banks trimmed, **85**, 1191.

**1886–87.** 5,131 trees, logs, stumps, and snags removed, 5 outlets closed, and 1 cut-off cleared, **87**, 1144, 1145.

**1888–89.** 1,815 trees and stumps and 87 cords of snags removed from the channel, and 1,041 trees and 212 cords of brush cut from the banks, **89**, 1169.

**1889–90.** 1,900 logs and trees and 106 cords of snags removed from the channel, and 1,705 trees removed from the banks, **90**, 1208.

**1890–91.** 640 stumps and snags cleared from the channel on the North Fork, and 1,200 snags and 485 trees from the channel and banks of the South Fork, **91**, 1482.

**1891–92.** 2,340 snags and 47 cords of small snags removed from the channel, and 1,733 trees and 378 cords of brush cleared from the banks, **92**, 1234.

**1892–93.** About 12,000 stumps and other obstructions removed from the channel and banks, and incidental work due to maintenance performed, **93**, 1519.

**Physical characteristics.**

Description, **81**, 1138, 1141.

**Projects.**

By Col. Gillmore, 1880, for enlarging and clearing channel, forming new channels across necks and bends, shutting off lateral channels, and removing logs, snags, and pile obstructions; also removing sand and dry shoals, and constructing deflecting jetty; estimate, $33,385, **81**, 1140; **86**, 180; **87**, 1143; **92**, 1233.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction Lt. Col. Gillmore, **81**, 1138.

Col. Gillmore charged by act of July 5, 1884, with preliminary examination of North Fork of Edisto River in counties of Orangeburg and Lexington, **85**, 191.

Examination of North Fork of Edisto River ordered by act of Aug 5, 1886, **87**, 154.

### Part B.—Edisto River, S. C., North Fork.

**Engineers.**

CHIEF OF ENGINEERS. Report, **88**, 138.

ENGINEER IN CHARGE. Capt. F. V. Abbot, 1888. Report, **88**, 991.

ASSISTANTS:

Capt. T. N. Bailey. Report, **88**, 993.

Lt. O. M. Carter. Report, **88**, 993.

**Physical characteristics.**

Description of, **88**, 992, 993.

**Survey.**

Examination ordered by act of July 5, 1884; made, 1884, under direction of Col. Gillmore (report unfavorable), **88**, 991.

### Part C.—Edisto River, S. C., North and South Forks (examination to connect by Saint Pierre River and South Creek).

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 158.

ENGINEER IN CHARGE. Capt. F. V. Abbot, 1888. Report, **89**, 1208.

**Physical characteristics.**

Description of, **89**, 1208.

**Survey.**

Examination ordered by act of Aug. 11, 1888; made, 1888, under direction of Capt. Abbot (report unfavorable), **89**, 1208.

## EEL RIVER, CAL.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 352.

ENGINEER IN CHARGE. Maj. W. H. Heuer, 1888. Report, **89**, 2493.

**Physical characteristics.**

Description of, **89**, 2493.

**Survey.**

Examination ordered by act of Aug. 11, 1888; made, 1888, under direction of Maj. Heuer (report unfavorable), **89**, 2493.

## EGYPTIAN LEVEE, DES MOINES RIVER, IOWA. (See *Mississippi River.*)

## EIGHTEEN-MILE CREEK, N. Y. (See *Olcott Harbor.*)

## EL ESTERO (ESTERO BAY) (near Santa Barbara), CAL.[a]

**Commerce.**

Unimportant, **73**, 1149, 1150.

**Engineers.**

CHIEF OF ENGINEERS. Report, **73**, 109.

ENGINEER IN CHARGE. Lt. Col. C. S. Stewart. Report, **73**, 1148, 1149.

**Plans.**

By Lt. Col. Stewart, for excavating a basin, constructing stone jetties, breakwater, and fender piling, $8,145,954 to $9,537,454, **73**, 1150.

**Survey.**

Examination by Lt. Col. Stewart, **73**, 1148.

## ELIZABETH RIVER, N. J.

**Appropriations.**

| | | |
|---|---|---|
| 1879, | $7,500, | **80**, 545. |
| 1880, | 7,500, | **80**, 545. |
| 1881, | 4,000, | **81**, 707. |
| 1882, | 8,000, | **82**, 698. |
| 1890, | 5,000, | **90**, 853. |
| 1892, | 5,000, | **92**, 879. |
| 1894, | 3,000, | **95**, 979. |
| 1896, | 3,160, | **96**, 780. |
| Total, | 43,160 | |

**Commerce.**

Important, **79**, 481, 483; **82**, 698.

Prospective benefit to commerce from improvement, **88**, 649.

Description of, **97**, 1186.

**Contracts.**

**1879.** E. G. Brown, dredging, 37 cents per c. y., **80**, 545.

**1880.** T. H. Benton, dredging, $1.05 per c. y., **81**, 707.

**1881.** T. H. Benton, dredging, $1.05 per c. y., **82**, 698.

**1882.** F. C. Somers, dredging, 63 cents per c. y., **83**, 581.

**1891.** R. Parrott, dredging, 55 cents per c. y., **91**, 994.

**1894.** W. H. Taylor, dredging, 76¼ cents per c. y., **94**, 805.

**1895.** J. McSpirit & Sons, dredging, 68 cents per c. y., p. m.; ledge removal, $2 per c. y., p. m., **96**, 779.

**1897.** J. McSpirit, dredging, 34 cents per c. y., p. m. ($2,800), **97**, 1135.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 63; **79**, 67, 75; **80**, 88; **81**, 111; **82**, 112; **83**, 108; **84**, 115; **85**, 106; **86**, 110; **87**, 69; **88**, 69; **89**, 89; **90**, 79; **91**, 100; **92**, 103; **93**, 111; **94**, 100; **95**, 112, 121; **96**, 96; **97**, 131, 141; **98**, 137; **99**, 157; **1900**, 179.

ENGINEERS IN CHARGE:

Col. J. N. Macomb, 1878–79; **78**, 63; **79**, 66, 74. Report, **79**, 481.

Lt. Col. N. Michler, 1880–83. Reports, **80**, 545; **81**, 706.

Lt. Col. G. L. Gillespie, 1883–86. Reports, **83**, 581; **84**, 748; **85**, 754.

Lt. Col. W. McFarland, 1886. Report, **86**, 785.

Lt. G. McC. Derby, 1886–89. Reports, **87**, 768; (Capt.) **88**, 648.

Capt. T. L. Casey, 1889–94. Reports, **89**, 827; **90**, 852; **91**, 993; **92**, 878; **93**, 1113; **94**, 804.

Lt. Col. G. L. Gillespie, 1895. Reports, **95**, 978, 1011.

Maj. H. M. Adams, 1896–97. Reports, **96**, 778; **97**, 1134, 1185.

Maj. A. M. Miller, 1898. Report, **98**, 1061.

Col. J. W. Barlow, 1899–. Reports, **99**, 1305; **1900**, 1503.

ASSISTANT. A. Doerflinger, **79**, 481. Report, **79**, 481.

**Operations.**

**1879–80.** 7-f. channel, 60 f. wide and 4,110 f. long, excavated, **80**, 545.

**1880–81.** 9,200 c. y. dredged, **81**, 706.

**1881–82.** 3,335 c. y. dredged, **82**, 697.

**1882–83.** 4,142 c. y. dredged, **83**, 581.

**1883–84.** 6,952 c. y. dredged, **84**, 748.

**1884–85.** Project completed according to requirements of commerce, **85**, 754.

**1890–91.** Excavation of channel begun, **91**, 993.

**1891–92.** 6,917 c. y. dredged, **92**, 879.

**1893–94.** 5,200 c. y. dredged, **94**, 805.

**1895–96.** 2,211 c. y. dredged and 394 c. y. shale rock removed, **96**, 779.

**1897–98.** 7,669 c. y., p. m., dredged, **98**, 1061.

**Physical characteristics.**

Description of, **79**, 481, 482; **95**, 1012; **97**, 1185.

[a] About 1 mile from Santa Barbara. This waterway is distinct from Estero Bay.

## ELIZABETH RIVER, N. J.—Continued.

Difference in tides, **79**, 482.

Description of the river; deterioration since suspension of work, **88**, 648, 649.

During the progress of dredging in 1894 fixed red shale was uncovered in the channel bed, **94**, 805.

Tidal observations, **95**, 1012.

Distances above the river mouth of the several bridges and other points, **96**, 778.

Stream subject to shoaling, **98**, 1061.

The stream enters the Arthurkill, in the eastern part of New Jersey, about 11 miles from New York City, and flows along the southerly part of the city of Elizabeth for about 2 miles. The sewage from the latter city a cause of the decrease in the natural depth of the stream. **97**, 1185, 1186.

**Projects.**

By Col. Macomb, 1879, for dredging a channel 60 f. wide to a depth of 7 f. at m. h. w. from the mouth to Broad street bridge, 2.7 miles, removing 44,000 c. y.; estimated cost, $25,530, **79**, 67, 482, 483.

Estimate increased in 1881 by Lt. Col. Michler to $43,160 from increased cost of dredging, **81**, 707; **87**, 768; **92**, 879.

In 1892, by Capt. Casey, for expenditure of appropriation of 1892 in dredging between the bridges at South street and Bridge street to a depth of 7 f. at m. h. w., and widths of 40 to 50 f., **93**, 1113.

In 1897 Maj. Adams estimated it would cost $12,000 for further improvement of the river, with an annual expenditure of $6,000 for maintenance, **97**, 1187.

**Surveys.**

Ordered and in progress, **78**, 63.

Completed by A. Doerflinger, **79**, 69, 75, 481.

Survey made by Capt. Casey, 1892, **93**, 1113.

Examination to ascertain the desirability of placing locks at the mouth of the river ordered by act of Aug. 17, 1894, made by Lt. Col. Ludlow, 1894 (report unfavorable), **95**, 1011.

Survey ordered by act of June 3, 1896, made by Maj. Adams, 1897 (report unfavorable), **97**, 1185.

## ELIZABETH RIVER, VA. (See *Deep Creek Branch of Elizabeth River, Va.; Hospital Point, Va.; Lynn Haven Bay, Va., and Norfolk Harbor, Va.*)

**Appropriations.**

| | | |
|---|---|---|
| 1829, | [a]$80 | (survey), act Mar. 2. |
| 1873, | [b]15,000, | **73**, 76, 785. |
| 1874, | [b]10,000; | **74**, 87, ii, 58. |
| 1875, | [b]5,000, | **75**, 94, ii, 127. |
| 1876, | [b]5,000, | **76**, 68, 351; **77**, 352. |
| 1878, | [b]5,000, | **78**, 73, 515. |
| 1896, | [c]45,000, | **96**, 1071. |
| 1898, | 360,000, | **99**, 1473. |
| Total, | 445,080 | |

**Commerce.**

The shipments of lumber from West Norfolk in 1894 amounted to $225,000, and freight amounting to about 600,000,000 pounds was received in 1893 and 1894 by the Atlantic & Danville Rwy., for shipment from West Norfolk by water; during the same period about 42,000,000 pounds were received by water for shipment by this railway from West Norfolk, **95**, 1301.

**Contracts.**

**1873.** G. H. Ferris, dredging 29,500 c. y., **74**, 87, ii, 58.

**1874.** Marshall Parks, dredging 11,855 c. y., **74**, 87, ii, 58. H. E. Culpepper, dredging 27,709.75 c. y., **75**, 93, ii, 127.

**1875.** H. E. Culpepper, dredging, **76**, 351.

**1877.** T. P. Morgan, dredging, **77**, 361.

**1878.** H. E. Culpepper, dredging, 27 cents per c. y., **79**, 680.

**1896.** P. S. Ross, dredging, 8.4 cents per c. y., s. m. ($40,500), **97**, 1366.

**1898.** American Dredging Co., dredging 2,241,380 c. y. in Elizabeth River, at 14½ cents per c. y., s. m., **99**, 1474.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 76; **72**, 71, 72; **73**, 76; **74**, 86; **75**, 93; **76**, 67; **77**, 65; **78**, 72; **79**, 89; **91**, 153, 1307; **95**, 177; **96**, 154; **97**, 191, **98**, 195; **99**, 224, 225, 232; **1900**, 256.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1871–74. Reports, **71**, 585; **72**, 715; **73**, 785; **74**, ii, 57.

S. T. Abert, U. S. C. E., 1874–78, **75**, ii, 110. Reports, **75**, ii, 125; **76**, 351; **77**, 361; **78**, 514.

Capt. C. B. Phillips, 1878–1879. Report, **79**, 679.

Lt. G. J. Fiebeger, 1890. Report **91**, 1308.

Capt. T. L. Casey, 1894–99. Reports, **95**, 1298, 1300; **96**, 1071; **97**, 1365; **98**, 1225; (Maj.) **99**, 1473, 1474, 1485.

Maj. J. B. Quinn, 1900–. Report, **1900**, 1765.

ASSISTANTS.

Capt. C. B. Phillips. Report, **72**, 718.

J. E. Weyss, **72**, 718, 720.

G. Thompson, **72**, 718, 720.

G. H. Elliott. Report, **79**, 681.

[a] Deep Creek. [b] South Branch. [c] Western Branch.

## ELIZABETH RIVER, VA.—Continued.

**Estimates.** (See *Projects.*)

By Capt. Phillips, 1872, for dredging 7-f. channel to the lock of the Albemarle & Chesapeake Canal, $18,000, **72**, 716, 720; increased to $25,000 by Maj. Craighill, **72**, 716, 718; **73**, 785; in 1874 increased $5,000, **74**, ii, 58.

By S. T. Abert, 1875, increased $8,500, **75**, 87, ii, 127; **76**, 351; increase from $25,000 to $40,000 owing to increase of traffic, **78**, 514; **79**, 679.

**Operations.**

**1872–73.** Dredging by contract, **73**, 76, 785.

**1873–74.** 5,400 y. channel dredged 60 f. by 7½ f., **74**, 86, ii, 57.

**1874–75.** Dredging through Nicaragua and Deep Creek bars; 27,709¾ c. y. removed, **75**, 93, ii, 126.

**1875–76.** Dredging channel 60 f. by 7½ f. from canal lock to near Parks Gap, **76**, 67, 351.

**1877–78.** A cut-off dredged near the lock and the gap widened, **78**, 72, 514.

**1878–79.** 14,914 c. y. dredged; a wreck and snags removed, **79**, 89, 679, 681.

**1896–97.** 378,037 c. y., s. m., dredged from the Western Branch, **97**, 1366.

**1897–98.** 103,996 c. y., s. m., dredged from the Western Branch and project completed, **98**, 1225.

**1898–99.** 2,361,775 c. y. dredged from Elizabeth River, **99**, 1473.

**Physical characteristics.**

Description of, **72**, 716, 718; **75**, ii, 127; **91**, 1308.

The distance from the Deep Creek Lock to the Gilmerton Lock via the system in use in 1894 2 miles shorter than by the Deep Creek route, **95**, 1299. Description of the Western Branch, **95**, 1301.

**Private (corporate) work.**

A considerable amount expended from time to time by the Albemarle & Chesapeake Canal Co., **72**, 719.

**Projects.** (See *Estimates.*)

By Capt. Phillips, 1872, for 7-f. channel to the lock of the Albemarle & Chesapeake Canal, **72**, 716.

By S. T. Abert, 1875, for channel 80 f. by 8½ f., **75**, ii, 126; and deepening the approaches to Parks Gap, **75**, 94, ii, 127.

By Capt. Casey, 1896, for dredging a channel 200 f. wide and 20 f. deep, m. l. w., from the 20-f. contour in Norfolk Harbor for a distance of about 1 mile in the Western Branch of the Elizabeth River; estimated cost, $45,000, **96**, 1072.

Deficiency act of July 7, 1898, provided $360,000 for 28-f. channel 450 f. wide, m. l. w., from Hampton Roads to Norfolk Navy-Yard, **99**, 1473.

Maj. Casey estimated, 1899, it would cost $85,000 to improve Deep Creek, **99**, 1485.

**Surveys.**

Under direction of Maj. Craighill, by Capt. Phillips, assisted by J. E. Weyss and G. Thompson, **72**, 715, 718.

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Fiebeger (report unfavorable), **91**, 1308.

Examination of the Deep Creek Branch of the river to obtain a depth equal to that of the Lake Drummond Canal and the Southern Branch of the Elizabeth River ordered by act of Aug. 17, 1894, made, 1894, by Capt. Casey (report unfavorable), **95**, 1298.

Examination of the Western Branch of the Elizabeth River ordered by act of Aug. 17, 1894, made, 1895, by Capt. Casey (report favorable) (see *Projects*), **95**, 1301.

Concurrent resolution dated Dec. 20, 1898, called for estimate of cost of widening and deepening Deep Creek, Va., from South Branch of the Elizabeth River to the new lock at the Dismal Swamp Canal (see *Projects*), **99**, 1485.

Examination made, 1900, by Maj. Quinn, **1900**, 1765.

## ELIZABETHTOWN, ILL. (See *Ohio River.*)

## ELK CREEK, OHIO.[a] (See *Erie Harbor, Pa.*)

## ELK RIVER, MD.

**Appropriations.**

| | | |
|---|---|---|
| 1874, | $5,000, | **74**, 80, ii, 16. |
| 1875, | 5,000, | **75**, 85, ii, 62. |
| 1880, | 10,000, | **80**, 623. |
| 1881, | 5,000, | **81**, 855. |
| 1882, | 6,500, | **82**, 841. |
| 1890, | 10,000, | **91**, 1185. |
| 1892, | 5,000, | **92**, 969. |
| Total, | 46,500 | |

**Commerce.**

Description of, **1900**, 1668, 1669.

**Contracts.**

**1875.** A. A. Dodge, dredging, 25 cents per c. y., **76**, 62, ii, 282.

**1880.** G. H. Ferris, dredging, 24 cents per c. y., **81**, 855.

**1881.** G. H. Ferris, dredging, 33⅓ cents per c. y., **81**, 855.

[a] Survey—Report April 17, 1834; estimate $34,380 (H. Doc. No. 482, 55th Cong., 2d sess.).

## ELK RIVER, MD.—Continued.

**1883.** G. W. Parsons, dredging, 31 cents per c. y., **83**, 667.

**1891.** C. T. Caler, dredging, 12½ cents per c. y., **91**, 1185.

**1892.** C. T. Caler, dredging, 9.9 cents per c. y., p. m., **93**, 1209.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 77; **74**, 79, 89; **75**, 84; **76**, 62; **80**, 99; **81**, 131; **82**, 128; **83**, 132; **84**, 140; **85**, 132; **89**, 112; **90**, 102; **91**, 125; **92**, 125; **93**, 135; **94**, 124; **95**, 142; **99**, 203; **1900**, 230.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1873–85. Reports, **73**, 815; **74**, ii, 15, 81; **75**, ii, 61; **76**, 282; (Lt. Col.), **80**, 622; **81**, 853; **82**, 840; **83**, 666; **84**, 889.

W. F. Smith, U. S. Agent, 1885–. Report, **85**, 883; (Maj.), **90**, 965; **91**, 1184; **92**, 968; **93**, 1207; **94**, 888; **95**, 1126; **1900**, 1665, 1668.

ASSISTANTS.

W. Popp. Reports, **73**, 816; **74**, ii, 81, 82.

H. Bacon. Report, **75**, ii, 62.

Capt. C. B. Phillips, **76**, 282.

A. Stierle. Report, **90**, 965.

**Estimates.** (See *Projects.*)

By W. Popp, 7-f. channel, $28,000; 6-f. channel, $18,000, **73**, 815, 816.

Maj. Craighill, 1873, channels in both branches, 75 f. by 6 f., $36,000, or 50 f. by 6 f., $25,000, **74**, ii, 15, 82; **75**, 85, ii, 61.

**Operations.**

**1874–75.** About 900 f. of dike built by open purchase and hired labor; completed Oct. 31, 1874; 5,441 c. y. dredged, **75**, 85, ii, 62, 63.

**1875–76.** 15,565 c. y. dredged, **76**, 62, ii, 282.

**1879–80.** 15,565 c. y. dredged, **80**, 622.

**1880–81.** 22,557 c. y. dredged, **81**, 854.

**1881–82.** 11,139 c. y. dredged, **82**, 840.

**1882–83.** Old dike removed and bank sloped back, **83**, 667.

**1883–84.** Work of dredging and removal of old pier-head continued, **84**, 890.

**1884–85.** Dredging and pier removal completed, **85**, 883, 884.

**1891–92.** 56,069 c. y. dredged, **92**, 968.

**1892–93.** 45,255 c. y., p. m., dredged, and project completed, **93**, 1208.

**Physical characteristics.**

Description of, **73**, 816; **74**, ii, 82, 83; **90**, 966.

**Projects.** (See *Estimates.*)

By Lt. Col. Craighill, 1873, for channels 6 f. deep at low water and 75 f. wide, by dredging and diking in the Big Elk from Cedar Point to Elkton, and in Little Elk as far as Burnett's wharf; estimate, $36,000, **74**, 15, 82, 83; **80**, 622.

Amended to include 8-f. depth, dike renewal and crib removal, increasing the estimate to $38,600, **81**, 854, 855.

By Maj. Smith, 1890, excavating channel, from the upper wharves at the bridge to below Cedar Point, to a depth of 8 f. at m. l. w. and 100 f. wide; estimate, $24,000, **91**, 1184.

Maj. Smith, estimated, 1899, it would cost $166,665, with $2,000 annually for maintenance to restore navigable channel, **1900**, 1669.

**Surveys.**

An examination by W. Popp, under direction of Maj. Craighill. Reports, **73**, 815, 816; **74**, ii, 81, 82.

A resurvey under direction of Maj. Craighill, **76**, 282.

Resurvey made in 1883, **83**, 667.

Ordered by act of Aug. 11, 1888, made, 1890, under direction of Maj. Smith, **90**, 966.

Examination and survey ordered by act of Mar. 3, 1899, made 1899, by Maj. Smith, (report favorable) (see *Projects*), **1900**, 1667.

## ELK RIVER, ALA. AND TENN.

**Appropriation.**

1899, $4,000, **99**, 2307.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 279; **99**, 409, 410; **1900**, 467, 469.

ENGINEERS IN CHARGE:

Maj. W. R. King. Report, **85**, 1771.

Maj. D. C. Kingman, 1899–. Reports, **99**, 2306, 2308; **1900**, 2952, 3077.

ASSISTANTS:

E. R. Nelles. Report, **99**, 2954.

J. E. Hall. Report, **1900**, 3081.

**Obstructions.**

Ten wagon bridges, 2 railroad bridges, 6 milldams, and 20 fish-trap dams the principal obstructions to navigation, **99**, 2307.

**Operations.**

**1899–1900.** About 7,000 snags and other obstructions, and 6,700 c. y. rock removed from river, and a training wall built with the excavated material, **1900**, 2955.

## ELK RIVER, ALA. AND TENN.—Continued.

**Physical characteristics.**

Until completion of Muscle Shoals Canal, Tennessee River, mouth of river would be inaccessible, **85**, 1771.

Description of, **99**, 2306, 2308; **1900**, 3078.

Situation of obstructions removed, **1900**, 2955.

Description of, discharge observations, and soundings, **1900**, 3081.

**Projects.**

By Maj. Kingman for removal of fishtrap dams from the channel from the last milldam near the crossing of the Louisville & Nashville R. R. to the mouth, together with bar at the mouth; estimated cost, $4,000, **99**, 2307.

Maj. Kingman estimated, 1899, it would cost $882,854.61 to secure a 4-f. navigation from Tennessee River to Fayette, **1900**, 3080.

**Surveys.**

Examination ordered by act of July 5, 1884, made under direction of Maj. King (report unfavorable), **85**, 1771.

Survey ordered by act of May 4, 1898; preliminary report submitted, 1899, by Maj. Kingman, **99**, 2308; final report submitted, 1899 (see *Projects*), **1900**, 3077.

## ELK RIVER, W. VA.

**Appropriations.**

1875, $500, allotment for survey, **76**, ii, 166.
1878, 5,000, **79**, 80, 556.
1880, 5,000, **80**, 691.
1881, 5,000, **81**, 917.
1882, 2,000, **82**, 931.
1886, 1,500, **86**, 1598.
1888, 3,000, **88**, 1760.
1890, 2,500, **90**, 2248.
1892, 2,500, **92**, 2064.
1894, 2,000, **95**, 2460.
1896, 2,000, **96**, 2262.

Total, 31,000

**Commerce.**

Mineral products of valley, **76**, ii, 171, 173, 175, 176.

Commerce of river mostly logs, **79**, 555.

Description of commercial possibilities, **95**, 2468.

Commerce entirely in timber and timber products diminished from 139,800 tons in 1892 to 55,500 tons in 1898, **99**, 3394.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 91; **79**, 80; **80**, 108; **81**, 147; **82**, 143; **83**, 147; **84**, 150; **85**, 286; **86**, 281; **87**, 251; **88**, 224; **89**, 260; **90**, 234; **91**, 300; **92**, 287; **93**, 326; **94**, 299; **95**, 334, 336; **96**, 290; **97**, 380; **98**, 365; **99**, 429, 440; **1900**, 493, 503.

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1876–95; **76**, 91. Reports, **76**, ii, 166; **79**, 555; (Lt. Col.), **80**, 690; **81**, 917; **82**, 931; **83**, 716; **84**, 936; **85**, 1857; **86**, 1598; **87**, 1923; (Col.), **88**, 1760; **90**, 2247; **91**, 2427; **92**, 2064; **93**, 2595; **94**, 1963.

Capt. T. Turtle, 1889. Report, **89**, 1955.

Lt. Col. P. C. Hains, 1895–97. Reports, **95**, 2460, 2466; **96**, 2262.

Maj. J. F. Gregory, 1897. Report, **97**, 2565.

Maj. W. H. Bixby, 1898. Report; **98**, 2137.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2495; **1900**, 3337, 3392.

ASSISTANTS:

N. H. Hutton, **76**, ii, 166. Report, **76**, ii, 167.

C. Humphries, **76**, ii, 166, 171.

Lt. T. Turtle. Report, **80**, 692, 695.

Capt. E. H. Ruffner. Reports, **81**, 917; **82**, 931.

A. M. Scott. Reports, **84**, 936; **85**, 1858; **86**, 1599; **92**, 2064; **93**, 2595; **95**, 2460. **97**, 2565; **98**, 2137; **99**, 2495; **1900**, 3339.

W. A. Porter. Report, **89**, 1956.

**Estimates.** (See *Plans* and *Projects.*)

For an open navigation by sluices through shoals, $100,000, **76**, ii, 166, 171. For slack-water navigation, by 22 locks and dams, if of masonry, $1,543,080; if of timber and masonry, $1,000,000, **76**, ii, 167, 170; **79**, 555.

**Legal proceedings.**

Toward removal of obstructing lock and dam near Charleston, **84**, 937; **85**, 1856; **86**, 1598.

Two dams obstruct navigation. Condemnation proceedings were instituted against one; suit dismissed. Commissioner's price regarded as excessive. An indictment brought against the owner of the other dam. **99**, 2495.

**Legislation.**

Act of State legislature providing for removal of dams, **87**, 1923.

**Obstructions.**

River obstructed by milldams, **80**, 692. Dilapidated condition of corporate lock and dam near Charleston makes it an obstruction to navigation, **82**, 143, 931, 933; **83**, 716; **84**, 937.

Recommendation by officer in charge that all operations be suspended until this obstruction is remedied, **82**, 934; **83**, 716; **85**, 1858.

Several small grist and saw mill dams obstructions, **94**, 1963. Proceedings to

## ELK RIVER, W. VA.—Continued.

be instituted for their removal, **95**, 2460. Progress of the proceedings (see *Legal proceedings*), **96**, 2262; **97**, 2565; **98**, 2137.

**Operations.**

**1879–80.** Removal of rocks, trees, and gravel bars, **80**, 109, 693,

**1880–81.** Removal of rock and construction of gravel and stone dikes at shoals, **81**, 147, 917.

**1881–82.** Formation of chutes and dikes at shoals, **82**, 731.

**1883–84.** Removal of rocks from channel, **84**, 936.

**1884–85.** Removal of obstructions from channel, **85**, 1858.

**1888–89.** 5,471 c. y. rock blasted and removed from the channel, **89**, 1958.

**1890–91.** 153 snags and 18 rocks removed from the channel, **91**, 2427.

**1891–92.** 4,418 c. y. rock blasted and removed in the upper river; 2,460 c. y. rock and 7,670 l. f. of round timber used in dike construction at points below Clay Court-House, **92**, 2065, 2066.

**1892–93.** Chutes cleared and widened; chute walls built and repaired; passageways opened through four abandoned dams; some snags and other obstructions removed, **93**, 2595.

**1897–98.** Some obstructions removed; dikes at Queens Shoal chute raised one-half f. for 500 f., **98**, 2137.

**1899–1900.** 3,000 c. y. rock blasted and scattered and some snags removed, **1900**, 3339.

**Physical characteristics.**

Pools, character of; width of river; fall of; discharge of; freshets on, **76**, ii, 166, 168.

Geological formation of valley of, **76**, ii, 172.

Mineral springs, **76**, ii, 173, 176.

Cement rock, **76**, ii, 176; **79**, 1417.

One of the principal tributaries of the Great Kanawha River, and a tortuous stream with an average width of 200 f. between banks, **99**, 3393.

**Plans.** (See *Estimates* and *Projects.*)

An inadequate navigation from mouth to Braxton Court-House, 100 miles, for a depth of 1 f. and width of 10 f., by cutting sluices through shoals, **76**, ii, 166, 169. Slackwater navigation to depth of 4 f. from mouth to Braxton Court-House, 100 miles, by means of 22 locks and dams, locks 120 f. by 24 f.; average lift, 8 f., **76**, ii, 167, 169, 170. Small need of improvement, **79**, 555.

**Private (State) work.**

Poorly built and badly located dam and lock, built by State, 2½ miles above mouth; should be removed, **76**, ii, 167, 169, 170.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Craighill, 1875, improving channels through shoals to a depth of 10 or 12 inches at l.-w. by cutting sluiceways 12 f. wide; also the removal of rocks, snags, and overhanging trees. Estimated cost, $100,000, **76**, ii, 166, 171; **79**, 555; **80**, 691; **81**, 147; **85**, 286.

By Maj. Craighill, 1879, for expenditures of appropriation of 1878 ($5,000) in removing obstructions; small occasion for improvement, **79**, 80, 555.

**Surveys.**

From mouth to Braxton Court-House, 1875, 100 miles, **76**, 91, ii, 166, 167.

Notes from previous civil surveys, **76**, ii, 166, 167, 171.

Value of level and micrometer attachment to transits for rapid surveys, **76**, ii, 171.

Examination of the river, with a view to locking and damming, ordered by act of Aug. 17, 1894. Report (unfavorable) rendered by Col. Craighill, 1894, **95**, 2466.

Examination of Elk River from its mouth to Sutton, ordered by act of Mar. 3, 1899, made, 1899, by Capt. Hodges (report unfavorable), **1900**, 3393.

## ELLIS ISLAND. (See *Hudson River; Jersey City to.*)

## EL MORO HARBOR, CAL. (See *Estero Bay, Cal.*)

**Commerce.**

Commerce unimportant, but in 1895 the locality was thought worthy of improvement by the Government, on account of the large supply of stone to be obtained from it for river and harbor work at a comparatively low cost if the harbor were improved, **95**, 3281.

**Engineers.**

CHIEF OF ENGINEERS. Report, **95**, 435.

ENGINEER IN CHARGE. Lt. Col. W. H. H. Benyaurd, 1895. Report, **95**, 3278.

**Physical characteristics.**

Description of, **95**, 3279.

Situated about the middle of the coast boundary of San Luis Obispo County, about 200 miles distant southward from San Francisco Bay. The basin which forms the harbor is about 4 miles long. **95**, 3279.

Description of changes effected in the harbor since survey by Col. Mendell in 1873, **95**, 3279.

**Survey.**

Examination ordered by act of Aug. 17, 1894, made in that year by Lt. Col. Benyaurd (report favorable), **95**, 3278.

## EMBARRAS RIVER, ILL.

**Commerce.**
None at 1892. Outlook for future not favorable. **93**, 2574.

**Engineers.**
Chief of Engineers. Report, **93**, 324.
Engineer in Charge. Lt. Col. J. G. Lydecker, 1892. Report, **93**, 2573.
Assistant. O. L. Petitdedier. Report, **93**, 2574.

**Physical characteristics.**
Description of. About 180 miles long, shallow, and obstructed by numerous snags, etc. **93**, 2573.

**Survey.**
Examination ordered by act of July 13, 1892, made, 1892, under direction of Lt. Col. Lydecker (report unfavorable.) **93**, 2573.

## EMORY RIVER, TENN. AND VA. (See *Clinch River.*)

**Commerce.**
Important, **76**, 745, 746.
Description of. Small, but improvement of the stream would probably open up the adjacent rich country and increase the commerce. **93**, 2414; **97**, 2317.

**Engineers.**
Chief of Engineers. Report, **76**, 87; **93**, 308; **97**, 354.
Engineers in Charge:
Maj. W. McFarland, **76**, 87. Report, **76**, 745.
Lt. Col. H. M. Robert, 1892. Report, **93**, 2413.
Capt. J. Biddle, 1893. Report, **93**, 2413.
Capt. D. C. Kingman, 1897. Report, **97**, 2316.
Assistants:
W. M. Gordon. Report, **76**, 745.
Lt. J. Biddle. Report, **93**, 2415.

**Estimates.** (See *Plans.*)

**Physical characteristics.**
Description of, **76**, 745, 746; **97**, 2317.
Wholly in Tennessee; enters Clinch River about 4 miles above where the Clinch enters Tennessee River. **97**, 2317.

**Plans.** (See *Projects.*)
Of Maj. MacFarland, 1876, for constructing 800 f. of wing dams and removing obstructions; estimate, $17,625; not recommended, **76**, 745, 746. Slackwater navigation reported impracticable, **76**, 746.

**Projects.** (See *Plans.*)
Lt. Col. Robert estimated, 1892, it would cost $600 for a survey, **93**, 2414.
Capt. Kingman estimated, 1897, it would cost $260,000 to construct a lock and dam to procure l. w. navigation to Harriman, **97**, 2316.

**Surveys.**
Examination above its mouth by W. M. Gordon, **76**, 87, 745.
Examination, mouth to Harriman, ordered by act of July 13, 1892, made, 1892, under the direction of Lt. Col. Robert (report favorable), **93**, 2413. Survey of the same part ordered by act of June 3, 1896, made, 1897, by Capt. Kingman (see *Projects*), **97**, 2316.

## EMPIRE BAY, MICH.

**Engineers.**
Chief of Engineers. Reports, **80**, 221; **81**, 301.
Engineer in Charge. Maj. F. Harwood, 1880. Report, **81**, 2258.

**Physical characteristics.**
Description of, **81**, 2259.

**Plans.**
(1) By Maj. Harwood, 1881, for harbor at North Bar Lake, channel of entrance 200 f. wide and 15 f. deep, made with 1,800 l. f. pile and brush pier and dredging; estimate, $60,000, **81**, 2260.
(2) Or for harbor at South Bar Lake, channel of entrance 200 f. wide, with depth of 10 f., made with 1,400 l. f. pile and brush pier 20 f. wide, and dredging; estimate, $40,000, **81**, 2261.

**Surveys.**
Ordered by act of June 14, 1880, made 1880, under direction of Maj. Harwood, **81**, 2258.

## EMPIRE, LAKE MICHIGAN.

**Engineers.**
Chief of Engineers. Report, **87**, 286.
Engineer in Charge. Capt. D. W. Lockwood, 1887. Report, **87**, 2209.

**Physical characteristics.**
Description of harbor, **87**, 2210.

**Survey.**
Examination, with a view to cutting a channel across the bar from Lake Michigan to Bar Lake, ordered by act of Aug. 5, 1886, made 1887, under direction of Capt. Lockwood (report unfavorable), **87**, 2211.

**ERIE.** (See *Lake Erie.*)

**ERIE AND HURON (channel to connect lakes).** (See *Huron and Erie, etc.*)

**ERIE BASIN, N. Y.** (See *Buffalo Harbor, N. Y.*)

**ERIE CANAL, N. Y.** (See *Wabash and Erie Canal.*)

**Commerce.**

Commercial aspects, detailed description of, and discussion of, **97**, 3263.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 473.

ENGINEER IN CHARGE. Maj T. W. Symons, 1897. Report, **97**, 3250.

**Physical characteristics.**

Description of the canal, **97**, 3251.

**Private work.**

Improvements under way and those contemplated by the State of New York, which owns the canal, **97**, 3254.

**Projects.**

Detailed estimates for enlargement of locks of the canal by the Government to allow of the passage of torpedo boats; total, $3,840,000 or $5,941,000, **97**, 3260.

**Surveys.**

In 1896 the Committee on Railways and Canals of the House of Representatives requested the Secretary of War to have made an examination to ascertain the practicability and probable cost of a proposed project contained in a House bill of the Fifty-fourth Congress, first session, for widening the locks of the Erie Canal to permit the passage of torpedo boats for the protection of lake cities. Report submitted by Maj. Symons, 1896. (See *Projects.*) **97**, 3250.

**ERIE (Presque Isle) HARBOR, PA.**[a] (See *Conneaut; Erie Harbor, Presque Isle Peninsula, Pa.*)

**Appropriations.**[b]

| | |
|---|---|
| 1823, | $150.00 (survey), act Mar.3. |
| 1824, | 20,000.00, **66**, iii, 31. |
| 1826, | 7,000.00, **66**, iii, 31. |
| 1827, | 2,000.00, **66**, iii, 31. |
| 1828, | 6,223.18, **66**, iii, 31. |
| 1829, | 7,390.25, **66**, iii, 31. |
| 1831, | 1,700.00, **66**, iii, 31. |
| 1832, | 4,500.00, **66**, iii, 31. |
| 1833, | 6,000.00, **66**, iii, 31. |
| 1834, | 23,045.00, **66**, iii, 31. |
| 1835, | 5,000.00, **66**, iii, 31. |
| 1836, | 15,122.80, **66**, iii, 31. |
| 1837, | 15,000.00, **66**, iii, 31. |
| 1838, | 30,000.00, **66**, iii, 31. |
| 1844, | 40,000.00, **66**, iii, 31. |
| 1852, | 30,000.00, **66**, iii, 31. |
| 1864, | 15,000.00 (allotment), **66**, iii, 31; **67**, 138, 145. |
| 1866, | 36,961.00, **66**, iii, 4, 31, iv, 1. |
| 1867, | 25,000.00, **67**, 31. |
| 1868, | 40,000.00 (allotment), **68**, 24, 42, 164. |
| 1869, | [c] 22,275.00 (allotment), **69**, 22. |
| 1870, | 20,000.00, **70**, 50; **71**, 48, 198. |
| 1871, | 29,000.00, **71**, 48, 198. |
| 1871, | [d] 10,000.00, (allotment), **71**, 48, 198. |
| 1872, | 15,000.00, **72**, 44, 234. |
| 1874, | 20,000.00, **74**, 52, 225. |
| 1875, | 80,000.00, **75**, 57. |
| 1876, | 40,000.00, **76**, 109, 142, ii, 566; **77**, 968. |
| 1878, | 25,000.00, **78**, 131, 1267. |
| 1879, | 25,000.00, **79**, 174, 1710. |
| 1880, | 25,000.00, **80**, 2186. |
| 1881, | 20,000.00, **81**, 2334. |
| 1882, | 20,000.00, **82**, 2417. |
| 1884, | 50,000.00, **84**, 2122. |
| 1886, | 37,500.00, **86**, 1880. |
| 1888, | 23,000.00, **88**, 2023. |
| 1890, | 40,000.00, **90**, 2797. |
| 1892, | 40,000.00, **92**, 2525. |
| 1894, | 10,000.00, **95**, 3140. |
| 1896, | 1,289.33, act May 11. |
| 1899, | 125,000.00, **99**, 3093. |
| Total, | 1,008,156.56 |

**Commerce.**

Requires channel to admit vessels drawing 14 f., **67**, 252.

Great increase of, **69**, 144.

Increasing, 1900; due probably to better channel and harbor, **1900**, 4107.

**Contracts.**

**1866.** J. Loveday, iron, **66**, iv, 74; **67**, 232, 233.

**1867.** Brooks & Adams, timber, **67**, 232, 233. Vincent & King,[e] materials and labor, **67**, 232, 233; **68**, 168–177, 188.

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[a] Surveys—Reports: Oct. 4, 1823, estimate $39,617.47; Oct. 1, 1835, estimate $97,000; Sept. 30, 1839, estimate $326,150; 1855, estimate $269,105.37; Nov. 12, 1864, estimate $15,000. Examination—Report (indefinite) Nov., 1833.

[b] Statement of appropriations from 1823, with method of expenditure, **83**, 1926.

[c] Called $22,500, **69**, 38, 144.

[d] Called $6,080, **72**, 44, 234. Allotted from appropriation for examination and survey of Northern and Northwestern Lakes, etc., **72**, 44, 234.

[e] Controversy between Col. Cram and contractors; history of the case, and plan for settlement submitted by Col. Cram, **68**, 168–177. Report of a Board of Engineers in relation to, **68**, 180–183.

**ERIE (Presque Isle) HARBOR, PA.**—Continued.

Lee & Dunbar, dredging, **67**, 232, 233; **72**, 233.

**1868.** Lee & Dunbar, dredging, **68**, 163, 168. William Nichols, repairing piers, **68**, 163, 168.

**1871.** Lee & Dunbar, dredging, 23 cents per c. y., **71**, 198; **73**, 343. H. W. Smith, pier work, completed, **71**, 198; **72**, 233.

**1872.** Lee & Dunbar, dredging, 29½ cents per c. y., **73**, 343; **74**, 224.

**1877.** O. J. Jennings, dredge, tug, and scows, $5.44 per hour, **77**, 970.

**1878.** W. H. McCurdy, iron, **78**, 1266. Ferris & Garfield, materials and labor, **78**, 1266.

**1879.** O. J. Jennings, dredging, 15 cents per c. y., **79**, 1710. Hemenway & Hayes, pier construction, **81**, 2187; amended, **81**, 2331. Cleveland, Brown & Co., pier construction, **80**, 2188. O. J. Jennings, dredging, 15 cents per c. y., **80**, 2189.

**1880.** G. W. & A. F. McKenzie, pile jetty construction, **80**, 2188. H. H. Hine, pier construction, **81**, 2334; annulled, **81**, 2331. H. B. Strong, pier construction, **81**, 2335. J. Barnett, iron, **81**, 2334. G. W. & A. F. McKenzie, pier construction, **81**, 2335.

**1881.** G. Talbot, dredging, 23 cents per c. y., **81**, 2336.

**1882.** J. L. Linn, removing and replacing old superstructure, **82**, 2418; dredging, 22½ cents per c. y., **82**, 2418.

**1886.** J. Rooney, dredging, 26 cents per c. y., **87**, 2346.

**1887.** D. McNaughton, iron, **87**, 2346. G. Elias & Bro., timber, **87**, 2346.

**1888.** J. L. Linn, dredging, 28 cents per c. y., **89**, 2347. O. Gillmore, dredging, 28 cents per c. y., **89**, 2347.

**1890.** Hingston & Wood, dredging, 18¼ cents per c. y., **90**, 2792. Benham & Doville, transporting material, **90**, 2793.

**1891.** J. B. Donnelly, pier extension, $61 per l. f., **91**, 2876.

**1892.** J. B. Donnelly, pier extension, $25,620, **93**, 3100.

**1896.** Hingston & Woods, dredging, 29,399 c. y., at 19 cents per c. y., s. m., riprap stone, 781 c. y., at $2.45 per ton, measured on boat, **97**, 3102.

**1898.** Carkin, Stickney & Cram, dredging, 17 cents per c. y., $1,110.95, **98**, 2746.

**1899.** Breymann Bros., dredging, 8¼ cents per c. y., $33,000, **99**, 3094. J. B. Donnelly, concrete superstructure of north pier, and extension of the pier, timber crib jetty construction (removing old works, furnishing stone, concrete, iron work, dredging, timber), $78,458.70, **1900**, 4107.

**Documents.** (Not printed in reports.)

Report of Board of Engineers of 1874 to consider plan for shore protection for Peninsula Point, **75**, 316.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 4, ii, 41, iii, 4, 31, iv, 2; **67**, 31, 252; **68**, 42, 177, 178; **69**, 22, 38; **70**, 49; **71**, 45, 47; **72**, 42; **73**, 45; **74**, 51; **75**, 56; **76**, 109, 142; **77**, 116; **78**, 130; **79**, 173; **80**, 228; **81**, 313; **82**, 308, 2420; **83**, 316; **84**, 319; **85**, 344; **86**, 339; **87**, 304; **88**, 277; **89**, 328; **90**, 297; **91**, 373; **92**, 352; **93**, 404; **94**, 378; **95**, 413; **96**, 369; **97**, 463, 473; **98**, 455; **99**, 536; **1900**, 604.

BOARD OF ENGINEERS:

Convened at Detroit Mar. 18, 1868, to consider causes of careening of cribs and remedy for. Adjourned, and reconvened at Erie Mar. 23. Examined the work and adjourned. Reconvened at Detroit, and recommended the use of cribs, 24 f. instead of 18 f. wide, grillage instead of tight bottoms, and riprap. Report, **68**, 179–183. (Col. Macomb, Lt. Cols. Newton, Raynolds, and Blunt, Maj. Wheeler, and Capt. Harwood.)

Convened at Erie Oct. 18, 1870. Recommended brush and stone construction in places, protection of beach by planting slips of poplar, beech, etc., and legislation to prevent the removal of standing or fallen timber, etc. Report, **71**, 206–208. (Lt. Cols. Woodruff and Foster, and Maj. McFarland.)

Convened by S. O., No. 49, C. of E., 1882, **82**, 2422. The Board did not consider the danger of a break through the peninsula of Presque Isle imminent, **82**, 2422.

ENGINEERS IN CHARGE:

Capt. T. W. Maurice, 1824, **67**, 138; **79**, 1707.

Col. Wm. Turnbull, 1855–56. Report, S. Doc. 42, 35th Cong., 1st sess.

Maj. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess.

Lt. Col. T. J. Cram, 1864–68. Reports, **66**, 13, 20, iv, 1–5, 73–75; **67**, 138, 148, 230–233, 254; **68**, 168–177, 183–185.

Maj. W. McFarland, 1868–71. Reports, **68**, 162–168; **69**, 142; **70**, 181; **71**, 200.

Capt. G. L. Gillespie, 1871; **71**, 189. Reports, **71**, 198, 200; **72**, 223.

Maj. F. Harwood, 1873–74. Reports, **73**, 342; **74**, 225.

Lt. Col. C. E. Blunt, 1874–78; **74**, 215. Reports, **75**, 316; **76**, ii, 563; **77**, 963, 968.

Maj. W. McFarland, 1878. Report, **78**, 1266.

Maj. J. M. Wilson, 1878–83. Reports, **79**, 1707; **80**, 2172; **81**, 2331; **82**, 2414, 2422.

## ERIE (Presque Isle) HARBOR, PA.—Continued.

Capt. M. B. Adams, 1883–84. Report, **83**, 1923.

Capt. E. Maguire, 1884–86. Reports, **84**, 2120; **85**, 2253; **86**, 1879.

Capt. C. F. Palfrey, 1886. **87**, 2343.

Capt. F. A. Mahan, 1886–90. Reports, **87**, 2343; **88**, 2017; **89**, 2343.

Maj. A. Stickney, 1890–92. Reports, **90**, 2789; **91**, 2869.

Maj. E. H. Ruffner, 1892–95. Reports, **92**, 2522; **93**, 3096; **94**, 2427; **95**, 3135.

Maj. T. W. Symons, 1896–. Reports, **96**, 3097; **97**, 3097, 3237; **98**, 2737; **99**, 3091; **1900**, 4099.

ASSISTANTS:

Capt. F. U. Farquhar, **66**, ii, 41, iv, 2.

I. Camp, **68**, 169, 172, 180. Report, **71**, 202, 205.

Capt. M. B. Adams. Report, **79**, 1710.

**Estimates.** (See *Projects.*)

By Board of Engineers, date not known, entire and permanent completion of eastern entrance, $56,760; western entrance, $212,345.37; total, $269,105.37, S. Doc. 1, 34th Cong., 1st sess.

By Maj. Graham, 1857, immediate repairs of piers, $8,638. Estimate of Board of Engineers revised to $83,091.86 for eastern entrance and $334,408.09 for western entrance; total, $417,499.95, S. Doc. 42, 35th Cong., 1st sess.

By Col. Cram, 1865, for dredging to 13 f., $15,126.90, and extension of north pier 500 f. to 13 f. of water, $21,835; total, $36,961.90, **66**, 4, 20, 21, 24, iv, 1, 73.

By Col. Cram, 1866, permanent completion, $25,000, **66**, iii, 4, 31.

By Col. Cram, 1867, repairs and dredging to 14 f., $69,000, **67**, 31.

By Maj. McFarland, 1868, repairing pier, $16,000; dredging outer bar, $5,000; dredging inner bar, $35,000, **68**, 164.

By Maj. McFarland, 1869, completion of work, $45,900, **69**, 143; **70**, 182.

By Maj. Harwood, 1873, entire and permanent completion of channel, beach protection, and repairs of piers, $75,000, **73**, 343. In 1874, $80,000, **74**, 225.

By Lt. Col. Blunt, 1875, extension of south pier, $50,000, **75**, 317.

By Lt. Col. Blunt, 1876, protection of shore, etc., $56,000, **76**, 106, ii, 566.

By Maj. Wilson, 1879, completion of existing project, $90,000, **79**, 1710.

**Legislation.**

Detailed history of efforts made by various persons to obtain the right to occupy the peninsula by State legislation. Letter sent by the Secretary of War to the governor of Pennsylvania in 1897 asking that the rights of the United States to ownership of the peninsula be confirmed. **98**, 2743.

**Operations.**

History of early operations, **79**, 1707; **80**, 2172; **82**, 2423.

**1855–56.** Closing breach in peninsula and protection of beach by brush work, S. Doc. 42, 35th Cong., 1st sess.

**1866–67.** Repairs of piers and protection of shore completed, **66**, 20.

**1867–68.** Repairs, pier extension, and dredging, **67**, 31, 139; **68**, 164.

**1868–69.** 380 linear feet of damaged pier repaired, **69**, 142.

**1869–70.** Removal of 60,000 c. y. from inner bar, channel 200 f. by 14 f.; 110 f. of piers rebuilt, **70**, 49, 181.

**1870–71.**. Removal of 25,317 c. y. from inner and outer bars; repairs to breakwater completed, **71**, 47, 48, 198.

**1871–72.** Extension of north pier 120 f.; removal of 63,877 c. y. from bars; north and south piers repaired; 51,300 assorted trees and roots planted on the neck of the peninsula, and shores protected by brush and stone, **72**, 44, 233, 234.

**1872–73.** Dredging, **73**, 45, 342.

**1873–74.** Dredging, **74**, 51, 224.

**1874–75.** About 18,000 c. y. dredged; north pier repaired; 1,472 f. of north spit protected by piles, brush, and stone, and 1,480 f. of beach protected by piles and plank bulkhead, backed by rubble, **75**, 57, 316.

**1875–76.** Dredging 52,800 c. y. from inner channel, 3,056 f. of pile-plank riprapped fence built, repairs to piers, and 500 f. of superstructure rebuilt over breakwater, **76**, 109, ii, 565.

**1876–77.** Extension of catch-sand fence 1,461 f., 415 f. of north pier rebuilt, and 28,594 c. y. of sand dredged, **77**, 116, 968.

**1877–78.** Dredging, rebuilding part of north pier, and extending catch-sand fence, **78**, 130, 1266.

**1878–79.** Dredging and rebuilding 400 l. f. of superstructure of north pier; piers repaired, **79**, 173, 1708.

**1879–80.** 102,763 c. y. sand dredged from channel; 10 snags removed, **80**, 2182.

**1880–81.** 160 l. f. crib work placed in north pier and 150 l. f. on south pier; 455 l. f. superstructure rebuilt on south pier; 11,808 l. f. piling driven in spur jetties; 2,000 l. f. brush and stone protection renewed, **82**, 2332.

**1881–82.** North pier extended 242 l. f. and riprapped with 1,200 tons large stone; strengthened by driving oak piles along 380 l. f. of channel face; south pier extended 423 l. f.; 25,000 c. y. material dredged, **82**, 2415.

**1882–83.** 385 l. f. north pier superstructure rebuilt and 90 f. redecked;

## ERIE (Presque Isle) HARBOR, PA.—Continued.

18,000 c. y. sand dredged; 193 piles driven for catch-sand jetty; pile protection at neck of peninsula completed, **83**, 1924.

**1883–84.** Extension of jetty at eastern end of peninsula, **84**, 2121.

**1884–85.** Minor repairs to north pier and south breakwater, **85**, 2253.

**1886–87.** Dredging between and in front of piers, **87**, 304, 2344.

**1887–88.** General repairs to piers and breakwater, **88**, 2021.

**1888–89.** 10,700 c. y. dredged; steam launch and boathouse built; minor repairs to piers and breakwater, **89**, 2347, 2349.

**1889–90.** Two breaches in breakwater repaired; minor repairs to breakwater and piers; 20,000 c. y. dredged, **90**, 2792, 2793.

**1890–91.** Repairs to south breakwater and north pier; 125,471 c. y. dredged from inner and outer channels, **91**, 2870.

**1891–92.** 2,800 c. y. dredged in outer channel; north pier extended 452 f.; repairs to breakwater and piers, **92**, 2522.

**1892–93.** Repairs to pier and breakwater, **93**, 3096, and extending of north pier in progress, **93**, 3097.

**1893–94.** Repairs to pier and breakwater, **94**, 2428; extending of north pier for 301.4 f. completed, and boathouse removed to another location, **94**, 2429.

**1894–95.** Repairs to piers and breakwater, **95**, 3136, 6,235 c. y., s. m., dredged, and steam launch repaired, **95**, 3137.

**1895–96.** Repairs to piers and breakwater, **96**, 3099.

**1896–97.** Repairs in progress at beginning of year completed, **97**, 3099, 29,399 c. y. dredged and 781 c. y. riprap stone placed along north pier, **97**, 3099; 2 wrecks removed, harbor lines established, and 2,400 locust trees planted, **97**, 3100.

**1897–98.** Repairs to piers and breakwater, **98**, 2739; 6,535 c. y. dredged, **98**, 2739; 2,000 locust trees planted on the peninsula, **98**, 2742.

**1898–99.** Presque Isle peninsula watched and trees on it tended; preparations made for work on existing project, **99**, 3093.

**1899–1900.** Extending of north pier completed; 203,174 c. y. dredged; timber crib jetty built at Presque Isle peninsula, and the peninsula watched, etc. (photographs), **1900**, 4102–4.

**Physical characteristics.**

Description, **71**, 200, 208; **75**, 316; **76**, ii, 564; **77**, 969; **88**, 2022; **96**, 3099, 3100, 3102; **97**, 3238–45.

Discussion of, **79**, 1713.

Table of gauge readings from 1875 to 1879, **79**, 1714.

Retrograde movement of shore line, **82**, 2420, 2423.

Water gauge raised 1.56 f., **97**, 3100.

Current observations made, **97**, 3100; **98**, 2740.

Shoaling along the Presque Isle peninsula, **1900**, 4105.

**Projects.** (See *Estimates.*)

By Board of Engineers, date not known, repair and extension of piers at eastern entrance to 12 f. of water; piers to form a western entrance at or near the breach in Peninsula Point, and checking abrasion and restoring the original water line of the island; estimate, $269,105.37, S. Doc. 42, 35th Cong., 1st sess.

By Col. Cram, 1865, dredging, repairs, and extension of piers by pile work to 13 f. of water; modified by Chief of Engineers, ordering cribs instead of pile piers; estimate, $36,961.90, **66**, 20, 21, iii, 4, iv, 1, 2.

By Col. Cram, 1867, 14 f. depth of channel; estimate, $54,666, **67**, 31, 139, 254; **68**, 43.

By Board of Engineers, 1868, increasing width of cribs from 18 f. to 24 f.; grillage and riprap, **67**, 179–183. Plans and specifications for this project by Col. Cram, **68**, 163, 183–185.

By Maj. McFarland, 1868, dredging inner channel 300 f. by 14 f., **68**, 164.

By Maj. McFarland, 1869, rebuilding south breakwater, **69**, 143; **70**, 181.

By Board of Engineers, 1870, protection and preservation of peninsula by planting slips of silver poplar or beech, brush and stone protection in places; estimate, $10,000, **71**, 48, 208.

By Board of Engineers, 1874, protection of north spit by construction of pile work and rubble stone, **75**, 316.

By Lt. Col. Blunt, 1875, extension of beach protection of pile and plank bulkhead or fence backed with rubble, **75**, 57, 316.

By Lt. Col. Blunt, 1876, extension of south pier, beach protection, thorough repairs of piers, and dredging, **76**, ii, 564–566; **77**, 969.

By Maj. Wilson, 1879, extension of north pier 800 f., south pier 1,600 f.; estimate, $120,000, **79**, 1708.

By Capt. Adams, 1879, shore protection by log and pile jetties, **79**, 1713.

In 1886 Capt. Maguire estimated that $84,120 would be required to extend the pier to the 16 f. curve and maintain a channel 16 f. deep between the harbor and deep water in the lake, **86**, 339.

In 1890 the project was modified by Maj. Stickney, extension of the north pier to the 18-f. curve; estimate, $96,000,

## ERIE (Presque Isle) HARBOR, PA.—Continued.

making the revised estimate for completion, including the appropriation of 1890, $47,657, **90**, 2796, 2797.

By Maj. Symons, 1897 (new and extended project), for repair and maintenance of existing structures; the extension of the north pier 500 f. and the south pier 1,000 f.; for dredging 20-f. channel at entrance, and at eastern end of bay a part needed for access to docks; for 4 protection jetties along the outer side of Presque Isle peninsula; and for maintenance of structures on and care of Presque Isle peninsula; estimate, $377,000, **97**, 3238; **99**, 3094.

**Surveys.**

By Maj. John Anderson, 1819, **79**, 1707.

By Capt. T. W. Maurice, 1823, **79**, 1707.

By Capt. Williams, 1830, **79**, 1707.

By Col. T. J. Cram, 1864, **79**, 1707.

By J. De La Camp, under direction of Col. Raynolds, 1865, **66**, 25; **71**, 200, 202.

By I. Camp, 1870, under direction of Maj. McFarland. Report, **71**, 202–205.

Under direction of Lt. Col. Blunt, **75**, 317.

Beach line survey, **80**, 2184.

Examination of harbor, 1881, **81**, 2332.

Examination of outer beach of peninsula, 1881, **81**, 2333.

Survey of peninsula, **85**, 2253.

Survey of Presque Isle Peninsula, made, 1888, under direction of Capt. Mahan, **88**, 2021; **89**, 2346.

Survey of the eastern end of the peninsula and harbor entrance, made by Maj. Ruffner, 1893, **94**, 2429.

Examinations of the channels made, 1894–95, by Maj. Ruffner, **94**, 2429; **95**, 3136.

Survey of the inner and outer channels made, 1895, by Maj. Symons, **96**, 3099.

Examination into the feasibility and advisability of improving the harbor by the construction of dikes to prevent closing by sand of the entrances, ordered by joint resolution of Congress; report submitted by Maj. Symons, 1896 (unfavorable), **96**, 3101.

Survey of the harbor ordered by act of June 3, 1896, made, 1897, by Maj. Symons (see *Projects*), **97**, 3237.

Examination of the channels made, 1898, by Maj. Symons, **98**, 2739.

MAPS:

Of Northern and Northwestern Lakes, showing location of harbor, **66**, i.

Of entrance to Erie Harbor, survey of Lt. Col. Raynolds, **66**, i.

List of maps, harbor and peninsula, **71**, 206.

**81**, 2238; **84**, 2122; **98**, 2742.

PHOTOGRAPHS. (See *Operations*, *1900*.)

## ERIE HARBOR, PRESQUE ISLE PENINSULA, PA. (See *Erie Harbor*, *Pa.*)

**Appropriations.**

1888, $60,000, **88**, 278.

**Contracts.**

1888, J. Friday, shore protection, $75,830, **89**, 2356.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **88**, 278; **89**, 329; **90**, 298; **91**, 374; **92**, 353; **93**, 405; **94**, 379; **95**, 413; **96**, 370.

BOARD OF ENGINEERS. Convened at New York City, January, 1890, to examine and report upon Capt. Mahan's project for shore protection. Report, **90**, 2800. (Cols. Abbot and Comstock and Lt. Col. Gillespie.)

ENGINEERS IN CHARGE:

Capt. F. A. Mahan, 1888–90. Report, **89**, 2353.

Maj. A. Stickney, 1890–92. Reports, **90**, 2799; **91**, 2877.

Maj. E. H. Ruffner, 1892–95. Reports, **92**, 2526; **93**, 3101; **94**, 2433; **95**, 3142.

Maj. T. W. Symons, 1896. Report, **96**, 3104.

**Legislation.**

Permission was given to the water commissioners of Erie, Pa., by Congress, to extend an intake pipe of the city water supply system across the bay, harbor, and peninsula, and thence out into Lake Erie, **93**, 3602, 3603.

**Operations.**

**1888–89.** 805 l. f. of shore protection built, **89**, 2354.

**1889–90.** 3,695 l. f. of shore protection built, **90**, 2800.

**1892–93.** Experiments in tree planting made, **93**, 3102.

**1895–96.** About 2,000 trees planted, and experiments made with grasses, **96**, 3105, 3106.

**Physical characteristics.**

Description of, **90**, 2801; **93**, 3102; **96**, 3104.

**Plans.**

By Capt. Mahan, 1889, for 6,000 l. f. of crib protection; estimate, $360,000, **90**, 2800.

**Projects.**

By Capt. Maguire, 1885, protection of the peninsula with pile and sheet pile work 6,000 f. long parallel with and about 100 f. from the shore; estimate, $173,000, **89**, 2353, 2355.

## ERIE HARBOR, PRESQUE ISLE PENINSULA, PA.—Continued.

In 1890 this project was abandoned, and it was recommended by the Board of Engineers that $20,000 be held in reserve to repair any possible breach through the peninsula, the further construction of shore protection being considered inadvisable, **90**, 2803, 2804. (Cols. Abbot and Comstock and Lt. Col. Gillespie.)

**Surveys.**

Examination with a view to planting trees on the peninsula for the purpose of increasing the growth thereon and strengthening of the neck made, 1893, by Maj. Ruffner, **93**, 3102.

Maps. **89**, 2354.

## ERIE LAKE AND OHIO RIVER, CANAL.[a]

## ESCAMBIA AND CONECUH RIVERS, ALA. AND. FLA.

| Part. | Appropriations. |
|---|---|
| A.—Escambia River, Fla | $10,500 |
| B.—Conecuh River, Ala | ...... |
| C.—Escambia and Conecuh rivers | 92,500 |
| Total | 103,000 |

### Part A.—Escambia River, Fla.

**Appropriations.**

1833, $5,000, act Mar. 2.
1836, 5,500, act July 2.

Total, 10,500

**Commerce.**

Important, **79**, 854.

**Engineers.**

Chief of Engineers. Reports, **78**, 81; **79**, 106.

Engineer in Charge. Capt. A. M. Damrell, 1878–85; **78**, 81. Report, **79**, 852.

Assistant. H. Haines. Report, **79**, 853.

**Physical characteristics.**

Obstructions, snags, logs, overhanging timber, and a bar at the mouth, **79**, 853, 856.

Season of high water, **79**, 853.

Tides, **79**, 856.

**Plans.** (See *Projects*, Part C.)

**Survey.**

By H. Haines, 1878–79. Report, **79**, 853.

### Part B.—Conecuh River, Ala.

**Commerce.**

Important, **79**, 843, 847.

**Engineers.**

Chief of Engineers. Reports, **78**, 81; **79**, 106.

Engineer in Charge. Capt. A. N. Damrell, 1878–1885; **78**, 81; **79**, 106. Report, **79**, 843.

Assistant. H. Haines. Report, **79**, 844.

**Physical characteristics.**

General, **79**, 844, 846.

Obstructions, snags, etc., **79**, 843, 845–847.

**Plans.**

By H. Haines, complete improvement of the river by removal of snags, by rock excavation, dredging, and construction of locks and dams; estimate, $241,865, **79**, 845, 848. For a partial improvement by the removal of snags and rocks; estimate, $62,430, **79**, 849. For removal of obstructions from Murder Creek, Sepulgah River, and their branches; estimate, $8,000, **79**, 850.

**Survey.**

Examination, 1878–79, by H. Haines. Report, **79**, 844.

### Part C.—Escambia and Conecuh Rivers, Ala. and Fla.

**Appropriations.**

1880, [b]$8,000, **80**, 1082.
1881, [b]5,000, **81**, 1199.
1882, 12,000, **82**, 1278.
1884 { [b]3,000, **84**, 1198.
1884 { [c]12,000, **84**, 1200.
1886, 12,000, **86**, 1176.
1888, 10,000, **88**, 1170.

**Appropriations**—Continued.

1890, 7,500, **90**, 1636.
1892, 8,000, **92**, 1418.
1894, 6,000, **95**, 1663.
1896, 4,000, **96**, 1396.
1899, 5,000, **99**, 1675.

Total, 92,500

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[a] Survey.—Report, Feb. 3, 1825. (H. Doc. No. 482, 55th Cong., 2d sess.) [b] Escambia. [c] Conecuh.

## ESCAMBIA AND CONECUH RIVERS, ALA. AND FLA.—Continued.

### Part C.—Escambia and Conecuh Rivers, Ala. and Fla.—Continued.

**Commerce.**

More than $2,000,000 a year, 1897. The amounts required to do the necessary work on this river only nine-tenths of 1 per cent of the annual commerce. **97**, 1632.

**Contracts.**

**1881.** W. A. Alexander, dredging, 47½ cents per c. y., **81**, 1290.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 137; **81**, 185; **82**, 182; **83**, 194; **84**, 202; **85**, 205; **86**, 203; **87**, 165; **88**, 153, **89**, 149; **90**, 161; **91**; 203; **92**, 199; **93**, 221; **94**, 204; **95**, 230; **96**, 204; **97**, 259; **98**, 255; **99**, 298; **1900**, 339.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1878–85. Reports, **80**, 1082; **81**, 1198; **82**, 1277; **83**, 1006, 1007; **84**, 1197.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1309; **86**, 1175; **87**, 1273; **88**, 1169.

Capt. P. M. Price, 1889–93. Reports, **89**, 1384; **90**, 1634; **91**, 1736; **92**, 1417; **93**, 1716.

Maj. F. A. Mahan, 1894–98. Reports, **94**, 1275; **95**, 1661; **96**, 1393; **97**, 1631; **98**, 1403.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1674; **1900**, 2129.

ASSISTANT. J. E. Turtle. Reports, **89**, 1384; **90**, 1635.

**Operations.**

**1881–82.** Channel 3,240 f. long, 100 f. wide, and 5½ f. deep at m. l. w. dredged through the bar (Escambia), **82**, 1277.

**1882–83.** 1,216 trees, snags, and stumps removed (Conecuh), **83**, 1007.

**1883–84.** Snags, trees, and obstructions removed throughout 85 miles of river (Escambia), **84**, 1198. Obstructions removed from 33 miles of river (Conecuh), **84**, 1199.

**1884–85.** 15,472 snags and trees removed (Conecuh), **85**, 1310.

**1885–86.** 10,943 logs, snags, and trees, and 105 c. y. rock removed from Conecuh and Escambia rivers, **86**, 1175.

**1886–87.** 2,569 trees, logs, and stumps, and 45 c. y. of rock removed from channel, **87**, 1274.

**1887–88.** 2,998 logs and snags removed from the channel, **88**, 1170.

**1888–89.** Removal of logs, snags, and similar obstructions, **89**, 1385.

**1889–90.** 530 snags and 153 c. y. rock and gravel removed from the channel, 20 trees cut from the banks, and 2,353 c. y. sand dredged, **90**, 1636.

**1890–91.** Repairs to snagging plant, **91**, 1736.

**1891–92.** 3,523 snags cleared from the channel, 19 c. y. gravel dredged, and 1,105 logs on banks cut up, **92**, 1417.

**1892–93.** 1,450 obstructions removed from banks and stream, **93**, 1717.

**1893–94.** About 600 obstructions removed, **94**, 1276.

**1894–95.** About 250 obstructions removed, **95**, 1662.

**1895–96.** About 2,200 obstructions removed, **96**, 1395.

**1896–97.** About 1,800 obstructions and 20 c. y. clay removed, **97**, 1632.

**1899–1900.** Snag boat built and 1,421 snags and other obstructions removed from the channel, **1900**, 2130.

**Projects.**

By Capt. Damrell, 1879, improving Escambia River from mouth to State line by dredging a channel 150 f. wide and 5½ f. deep at m. l. w. through the bar at the mouth, removing snags and similar obstructions, and by shore protection and wing-dam construction to obtain a 5-f. low-water channel throughout the length of the river; estimate, $25,000, **79**, 853, 856; **80**, 1082.

In 1882 $12,000 was appropriated for the Escambia and Conecuh rivers, when it was proposed to extend navigation to Indian Creek, 273 miles above the mouth of the river, by removal of obstructions, closing cut-off, and rock removal, at an additional estimate of $62,430 over the estimate of 1879, **83**, 1007; **87**, 1273. Total estimated cost of improvement, $87,430, **88**, 1169.

**Surveys.**

MAPS. **84**, 1198.

## ESOPUS CREEK, N. Y. (See *Saugerties Harbor.*)

## ESSEX BRANCH, MASS. (See *Crane and Water rivers.*)

## ESSEX RIVER, MASS.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1892, | $5,000, | **93**, | 748. |
| 1894, | 5,000, | **95**, | 606. |
| 1896, | 5,000, | **96**, | 593. |
| 1899, | 10,000, | **99**, | 1063. |
| Total, | 25,000 | | |

**Commerce.**

Description of, **91**, 677.

**Contracts.**

**1894.** Columbian Dredging Co., dredging 47,367 c. y., 19 cents per c. y., s. m., **95**, 606.

## ESSEX RIVER, MASS.—Continued.

**1897.** Eastern Dredging Co., dredging 14,516 c. y., 31 cents per c. y.; removal of bowlders, over 6 tons, $10, **97**, 831.

**1900.** A. B. Martin, dredging, 40 cents per c. y., s. m.; bowlder removal, over 3 tons, $4 ($6,000), **1900**, 1160.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 47; **93**, 41; **94**, 39; **95**, 49; **96**, 43; **97**, 48; **98**, 56; **99**, 65; **1900**, 72.

ENGINEERS IN CHARGE:

Lt. Col. S. M. Mansfield, 1890–98. Reports, **91**, 676, 677; **93**, 747; **94**, 536; **95**, 605; **96**, 592; **97**, 830; **98**, 852.

Col. C. R. Suter, 1899. Report, **99**, 1063.

Maj. W. L. Fisk, 1900. Report, **1900**, 1159.

ASSISTANT. T. T. H. Harwood. Report, **91**, 678.

**Operations.**

**1894–95.** About 13,000 c. y. dredged, **95**, 605.

**1895–96.** About 35,000 c. y. dredged, **96**, 593.

**1896–97.** About 13,500 c. y. dredged, **98**, 852.

**Physical characteristics.**

Description of, **91**, 678.

**Projects.**

By Lt. Col. Mansfield, 1891, channel 4 f. deep at m. l. w. and 60 f. wide from the river's mouth to the head of navigation at Essex, 3½ miles, by dredging and rock removal; estimate, $25,000, **91**, 677.

In 1893 Lt. Col. Mansfield recommended that available funds be held awaiting further appropriations, **93**, 748.

In 1894, by Lt. Col. Mansfield, for the use of available funds to obtain a channel 25 f. wide and 4 f. deep, **95**, 605.

In 1897, by Lt. Col. Mansfield, to obtain a channel the full width and depth from the drawbridge in Essex down the river as far as available funds would permit, **97**, 831.

In 1899 Col. Suter recommended that the improvement be limited to channel below the drawbridge, **99**, 1063.

**Surveys.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Lt. Col. Mansfield, **91**, 677.

MAPS. **91**, 678.

## ESTERO BAY (San Luis Obispo County), CAL. (See *El Moro Harbor, Cal.; Santa Barbara, Cal.*)

**Commerce.**

Not large, **73**, 1141.

**Engineers.**

CHIEF OF ENGINEERS. Report, **73**, 108.

ENGINEER IN CHARGE. Maj. G. H. Mendell. Report **73**, 1140.

**Plans.**

By Maj. G. H. Mendell, closing the southern channel, **73**, 1141.

**Surveys.**

Examination ordered by act of June 10, 1872, made by Maj. Mendell, **73**, 1140.

## ESTHERVILLE-MININ CREEK CANAL, S. C. (See *Santee River.*)

## ETOWAH RIVER, GA. (See *Mississippi River.*)

**Appropriations.**

1876, [a]$1,300, **77**, 92, 601; **78**, 105; **79**, 1272.

**Commerce.**

Not unimportant, **80**, 1693.

**Documents.** (Not printed in reports.)

H. Doc. 17, 46th Cong., 2d sess.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 64; **72**, 59; **77**, 92; **78**, 105; **79**, 141, 142; H. Doc. 17, 46th Cong., 2d sess.; **80**, 189; **81**, 256; **82**, 250.

ENGINEERS IN CHARGE:

Maj. W. McFarland, 1872. Reports, **72**, 481, 516.

Capt. W R. King, 1877–82. Reports, **77**, 601; **78**, 766; **79**, 1272; H. Doc. 17, 46th Cong., 2d sess.; (Maj.) **80**, 1693, 1694; **81**, 1874; **82**, 1858.

ASSISTANTS:

R. C. McCalla. Report, **72**, 527–535.

J. G. Long. Report, **72**, 543–551.

Lt. W. L. Marshall. Reports, **77**, 602; H. Doc. 17, 46th Cong., 2d sess.; **80**, 1694.

Ernst Ruhl, **79**, 1272. Reports, H. Doc. 17, 46th Cong., 2d sess.; **80**, 1695.

**Physical characteristics.**

Description, **72**, 532–535, 543–551, H. Doc. 17, 46th Cong., 1st sess.; **80**, 1694.

**Plans.**

By R. C. McCalla, 1872, canal, Owl Creek to Rome, 53 miles, $3,732,500, **72**, 535.

By J. G. Long, 1872, 3½ f. of water, railroad bridge, near Cartersville, to Rome, 50 miles, by dams and locks, $274,718, **72**, 481, 548–551.

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[a] Part of $10,000; the remainder of appropriation, $8,700, was transferred to Coosa River below Rome, Ga., by act of Aug. 2, 1882, **82**, 1858.

## ETOWAH RIVER, GA.—Continued.

By Maj. King, 1879, for improvement of 63 miles of river, giving a navigable channel 4 f. deep, by construction of 27 locks and dams; estimate, $2,276,663, **80**, 1698. Improvement not considered justifiable, **80**, 1693.

**Surveys.**

By R. C. McCalla, under direction of Maj. McFarland, from Owl Creek to Rome. Report, **72**, 480, 532–535.

By J. G. Long, under direction of Maj. McFarland, from railroad bridge near Cartersville, to Rome. Reports, **72**, 481, 543–551; **77**, 601, 602.

By Lt. Marshall, under direction of Capt. King, from Cartersville to Rome. Report, **77**, 601, 602.

By E. Ruhl, 1879, under direction of Capt. King and Lt. Marshall, from Little River to Rome. Report, H. Doc. 17, 45th Cong., 2d sess.; **80**, 1694–1701.

Ordered by act of June 18, 1878, made, 1879, under direction of Maj. King (see *Plans*), **80**, 1694.

## EUREKA HARBOR, CAL.

**Engineers.**

CHIEF OF ENGINEERS. Report, **71**, 98.

BOARD OF ENGINEERS. Convened Sept. 12, 1871, at San Francisco, Cal., to consider and report upon the practicability of improving the entrance to Humboldt Bay and Eureka Harbor, Cal. Report—impractical to build any permanent improvement at this point. Report, **71**, 921. (Lt. Cols. Stewart and Alexander and Maj. Williamson.)

**Surveys.**

Included in Coast Survey, **71**, 951.

## EVANSVILLE, IND. (See *Ohio River.*)

## EVERETT HARBOR, WASH. (See *Snohomish River.*)

**Appropriations.**

| | | |
|---|---|---|
| 1894, | $10,000, | **95**, 3433. |
| 1896, | 20,000, | **96**, 3375. |
| 1899, | 50,000, | **99**, 3273. |
| 1900, | 135,000, | **1900**, 4486. |

Total, 215,000

**Commerce.**

Description of, **93**, 3467; **97**, 3448.

In 1892, limited, **93**, 3467.

In 1897 it had grown in importance and was increasing, **97**, 3448.

**Contracts.**

**1895.** Everett Terminal Co., bulkhead construction—piles, 5 cents per l. f.; lumber, $7.30 per M. f.; spikes, 3 cents per pound; brush, $1.25 per cord ($3,760), **95**, 3432.

**1896.** Savage & Scofield, dike construction—stone, 82 cents per ton; piles, 5 cents per l. f.; lumber, $7.50 per M. f.; spikes, 3 cents per pound; brush, $1.30 per cord ($11,074). New York Dredging Co., dredging, 32,143 c. y., at 14 cents per c. y., **97**, 3449.

**1899.** Seattle Dredging Co., 2,350,000 c. y., dredging, at 9 cents; piles, $2,240; lumber, $910; fascines, $7,500; stone, $1,805, **1900**, 4486.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 446; **94**, 2623; **95**, 454; **96**, 412; **97**, 515; **98**, 518; **99**, 608; **1900**, 3273.

ENGINEERS IN CHARGE:

Capt. T. W. Symons, 1893–95. Reports, **93**, 3464; **94**, 2623; **95**, 3430.

Capt. H. Taylor, 1896–. Reports, **96**, 3373; **97**, 3447; **98**, 3075; **99**, 3273; **1900**, 4485.

**Operations.**

**1895–96.** A dike 7,980 f. long built, **96**, 3374.

**1896–97.** The dike extended 6,465 f. farther, and 32,143 c. y. dredged to make a channel 50 f. wide at bottom and 6 f. deep at m. l. w. for a distance of 2,885 f., **97**, 3448.

**Physical characteristics.**

Description of, **93**, 3465; **94**, 2624.

In 1892 Everett was a town one year old situated at the mouth of the Snohomish River, with a water frontage of about 9½ miles, but only a small proportion of which could be reached at all stages of the tide by ocean-going craft, **93**, 3465.

**Projects.**

In 1894 Capt. Symons estimated it would cost $372,000 to improve the harbor, **94**, 2626, by excavating a harbor basin, by dredging a channel from thence to the fresh water of the Snohomish River, and by protecting and maintaining this harbor and channel by a bulkhead between them and the open sound; the plan of improvement adopted, **95**, 3431.

In 1895, by Capt. Symons, for the construction of the bulkhead from the lower end of Smith's Island, for such length as the prices bid would permit, **95**, 3431.

**Surveys.**

Examination of the harbor, including the mouth of the Snohomish River, or-

## EVERETT HARBOR, WASH.—Continued.

dered by act of July 13, 1892, made in the same year by Capt. Symons (report unfavorable), **93**, 3464.

Survey and estimate of the cost of dredging the bar at Everett so as to construct a fresh-water harbor there with the greatest water depth practicable was called for by concurrent resolution of Congress dated June 20, 1894. Report submitted by Capt. Symons (see *Projects*), 1894, **94**, 2623.

Maps. **95**, 3434.

## EXAMINATIONS, SURVEYS, AND CONTINGENCIES.

Examination, surveys, and contingencies (see also *Waterways and canals*):

| | |
|---|---|
| June 23, 1866, | $255,000.00 |
| Mar. 2, 1867, | 255,000.00 |
| July 11, 1870, | 150,000.00 |
| July 15, 1870, | 50,000.00 |
| Mar. 3, 1871, | 175,000.00 |
| June 10, 1872, | 150,000.00 |
| Mar. 3, 1873, | 125,000.00 |
| June 23, 1874, | 75,000.00 |
| Mar. 3, 1875, | 50,000.00 |
| Aug. 14, 1876, | 40,000.00 |
| June 18, 1878, | 150,000.00 |
| Mar. 3, 1879, | 150,000.00 |
| June 14, 1880, | 150,000.00 |
| Mar. 3, 1881, | 50,000.00 |
| Aug. 2, 1882, | 150,000.00 |
| July 5, 1884, | 125,000.00 |
| Aug. 5, 1886, | 100,000.00 |
| Aug. 11, 1888, | 150,000.00 |
| Sept. 19, 1890, | 225,000.00 |
| July 13, 1892, | 125,000.00 |
| Aug. 18, 1894, | 125,000.00 |
| June 3, 1896, | 200,000.00 |
| Mar. 3, 1899, | 200,000.00 |
| Total, | [a]3,225,000.00 |

Preservation and repairs:

| | |
|---|---|
| Aug. 23, 1842, | 30,000.00 |
| June 11, 1844, | 20,000.00 |
| Aug. 30, 1852, | 10,000.00 |
| June 28, 1864, | $12,372.79 |
| Apr. 10, 1869, | 23,829.73 |
| Total, | 96,202.52 |

Roads and canals:

| | |
|---|---|
| Apr. 30, 1824, | 30,000.00 |
| Mar. 25, 1826, | 50,000.00 |
| Mar. 2, 1827, | 30,000.00 |
| May 19, 1828, | 30,000.00 |
| Mar. 2, 1829, | 30,000.00 |
| May 31, 1830, | 30,000.00 |
| Mar. 2, 1831, | 25,000.00 |
| July 3, 1832, | 30,000.00 |
| Mar. 2, 1833, | 25,000.00 |
| June 28, 1834, | 24,000.00 |
| Mar. 3, 1835, | 25,000.00 |
| July 2, 1836, | 25,000.00 |
| Mar. 3, 1837, | 30,000.00 |
| Total, | 384,000,00 |

Surveys, arrearages, etc:

| | |
|---|---|
| Feb. 21, 1825, | 28,567.00 |
| July 7, 1838, | 2,000.00 |
| Sept. 9, 1841, | 40,000.00 |
| Aug. 23, 1842, | 15,000.00 |
| Aug. 10, 1846, | 4,988.00 |
| Aug. 30, 1852, | 10,000.00 |
| Total, | 100,555.00 |

## EXETER RIVER, N. H.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $20,000, | **80**, 343. |
| 1881, | 15,000, | **81**, 497. |
| 1899, | 12,000, | **99**, 1049. |
| Total, | 47,000. | |

**Commerce.**

Important, **75**, ii, 427, 428.

Estimated amount of, **97**, 819.

**Contracts.**

**1881.** T. Symonds, dredging, at $1.06, 46 cents, 47 cents per c. y., **81**, 498.

**1900.** A. B. Martin, dredging, 54 cents c. y., s. m.; removal of bowlders greater than 3 tons in weight, $10 per ton, **1900**, 1150.

**Engineers.**

Chief of Engineers. Reports, **75**, 121; **80**, 68; **81**, 70; **82**, 70; **97**, 44; **99**, 61; **1900**, 67.

Engineers in Charge.

Lt. Col. Thom, 1875–82. Reports, **75**, 120; **75**, ii, 426; **80**, 342; **81**, 496; **82**, 504.

Maj. R. L. Hoxie; 1897. Report, **97**, 818.

Maj. S. W. Roessler, 1899. Report, **99**, 1048.

Maj. W. L. Fisk, 1900. Report, **1900**, 1149.

Assistants.

S. Haagensen. Report, **75**, ii, 428.

J. W. Walker. Report, **97**, 819.

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[a] $201,777.86 of this has been charged throughout the index to various works.

## EXETER RIVER, N. H.—Continued.

**Legislation.**

Purchase of right of way for projected cut-off at the Oxbow, **81**, 497.

**Operations.**

**1880–81.** 47,000 c. y. dredged and sunken wrecks removed by hired labor, completing projected improvement, **81**, 497.

**1899–1900.** 8,370 c. y. dredged, **1900**, 1149.

**Physical characteristics.**

Description of, **75**, ii, 427, 428.

List of obstructions, **75**, ii, 429, 430.

**Projects.**

By Col. Thom, 1875, channel 40 f. wide and 12 f. deep at m. h. w. to Oxbow, thence (with 10-f. depth at m. h. w. and the same width), by a cut-off through Oxbow, to upper wharves at Exeter, by dredging and removal of bowlders; estimate, $34,000, **75**, ii, 427, 429, 430; **81**, 496.

By Maj. Hoxie, 1897, for 12-f. channel, mouth to Oxbow; 10-f. channel from Oxbow to Exeter, 40 f. wide; and removal of bowlders; total estimate, $12,000, **99**, 1049.

**Surveys.**

Survey below Exeter, by S. Haagensen, 1874. **75**, 121, ii, 427, 428.

A survey was ordered by act of June 3, 1896, and was made by Lt. Col. Damrell in 1897 (restoration of old channel of 1881 recommended), **97**, 818.

## FAIRHAVEN HARBOR, MASS. (See *New Bedford Harbor.*)

## FAIRLEE CREEK, MD.

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $5,000, | **88**, 92. |
| 1890, | 5,000, | **90**, 936. |

Total, 10,000

**Contracts.**

**1889.** C. T. Caler, dredging, 23 cents per c. y., **89**, 899.

**1891.** C. T. Caler, dredging, 16 cents per c. y., **91**, 1187.

**Engineers.**

Chief of Engineers. Reports, **87**, 97; **88**, 92; **89**, 109; **90**, 99; **91**, 126; **92**, 126; **93**, 136; **94**, 125; **95**, 142; **96**, 129.

Engineer in Charge. W. F. Smith; U. S. agent, 1886–96. Reports, **87**, 854; (Maj.) **89**, 898; **90**, 936; **91**, 1186; **92**, 969; **93**, 1210; **94**, 888; **95**, 1127; **96**, 958.

Assistant. C. Humphreys. Report, **87**, 854.

**Operations.**

**1888–89.** 18,500 c. y. dredged, **89**, 898.

**1890–91.** 28,125 c. y. dredged, **91**, 1186.

**Physical characteristics.**

Description of, **87**, 855.

**Projects.**

By W. F. Smith, 1887, excavation of a channel across the bar at the mouth of the creek 7 f. deep and 100 f. wide; estimate, $15,450, **87**, 856; **91**, 1187; **92**, 970.

**Surveys.**

Ordered by act of Aug. 5, 1886, made, 1887, under direction of W. F. Smith, **87**, 855.

## FAIRPORT HARBOR (Grand River Harbor), OHIO.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1825, | $1,000.00, | **66**, iii, 32. |
| 1826, | 5,620.00, | **66**, iii, 32. |
| 1828, | 9,135.11, | **66**, iii, 32. |
| 1830, | 5,563.18, | **66**, iii, 32. |
| 1831, | 5,680.00, | **66**, iii, 32. |
| 1832, | 2,600.00, | **66**, iii, 32. |
| 1834, | 10,000.00, | **66**, iii, 32. |
| 1836, | 6,000.00, | **66**, iii, 32. |
| 1838, | 10,000.00, | **66**, iii, 32. |
| 1844, | 10,000.00, | **66**, iii, 32. |
| 1852, | 10,000.00, | **66**, iii, 32. |
| 1864, | 24,453.24, | **66**, iii, 32; **67**, 141. |
| 1866, | 24,072.00, | **66**, iii, 32. |
| 1867, | 60,000.00, | **67**, 141. |
| 1874, | 20,000.00, | **74**, 51. |
| 1875, | 15,000.00, | **75**, 164. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1876, | $5,000.00, | **76**, 142. |
| 1878, | 5,000.00, | **78**, 130, 1264. |
| 1880, | 3,000.00, | **80**, 2154. |
| 1881, | 10,000.00, | **81**, 2321. |
| 1882, | 10,000.00, | **82**, 2408. |
| 1884, | 10,000.00, | **84**, 2109. |
| 1886, | 18,750.00, | **86**, 1870. |
| 1888, | 10,000.00, | **88**, 2012. |
| 1890, | 30,000.00, | **90**, 2783. |
| 1892, | 35,000.00, | **92**, 2506. |
| 1894, | 20,000.00, | **95**, 3112. |
| 1894, | 5,434.18, | act of Aug. 8. |
| 1896, | 30,000.00, | **96**, 2955. |
| 1899, | 100,000.00, | **99**, 3066. |

Total, 511,307.71

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[a] Survey—Reports: 1825, estimate $26,997.81; Nov. 9, 1864, estimate $56,725. (H. Doc. No. 482, 55th Cong., 2d sess.

**FAIRPORT HARBOR (Grand River Harbor), OHIO**—Continued.

**Commerce.**
A harbor of refuge much needed, **66**, 22.
Local commerce of no importance, **67**, 219.
Description of, **95**, 3111.
In 1895–96 the harbor was third on the lake for shipments of coal and iron ore, and fifth in the total of all freight, **96**, 2955.
In 1896–97 the total receipts and shipments was nearly 2,000,000 tons, **97**, 3084.

**Contracts.**
**1866.** J. Loveday, iron, **66**, iv, 74.
**1867.** J. Loveday, iron, **67**, 232, 233. J. E. & D. E. Bailey, materials and labor, **67**, 232, 233. Brooks & Adams, materials, **67**, 232, 233.
**1872.** Hemenway & Garfield, materials, labor, and dredging, **72**, 230, 232; **73**, 339.
**1874.** Hemenway & Garfield, materials and labor, **75**, 311, 312. Cartwright & McCurdy, iron, **75**, 311, 312; **76**, ii, 562.
**1875.** Wilcox & Merry, materials and labor, **75**, 311, 312; **76**, ii, 562. W. H. McCurdy, iron, **75**, 311, 312; **76**, ii, 562.
**1879.** C. Schulz, materials and labor, **79**, 1698. S. A. Sprague, iron, **79**, 1699.
**1881.** D. M. Averill, pier repairs, **81**, 2321.
**1882.** E. H. French, dredging, 27 cents per c. y., **82**, 2409. J. Bennett, iron, **83**, 1915. C. T. Dennis, pier extension, **83**, 1914.
**1885.** W. E. Rooney, dredging, 23⅛ cents per c. y., **85**, 2236. C. D. Merry, pier extension and repairs, **85**, 2236.
**1886.** W. J. Starkweather, dredging, 28 cents per c. y., **87**, 2324. L. P. Smith, repair to piers, **87**, 2324.
**1887.** Kerr, Stang & Gillmore, pier extension, **87**, 2324.
**1888.** B. S. Harton, pier extension and repair, $6,144, **89**, 2398.
**1889.** Q. Gillmore, dredging, 25 cents per c. y., **89**, 2328.
**1890.** J. R. Irwin, dredging, 23 cents per c. y., **90**, 2781. American Transportation Co., dredging, 17½ cents per c. y., **91**, 2862. Q. Gillmore, pier extension and repair, $14,724, **91**, 2862.
**1891.** J. R. Irwin, dredging, 17½ cents per c. y., **92**, 2507.
**1893.** J. B. Donnelly, pier extension, approximate total of bid, $19,033.32, **93**, 3084. Sadler & Allen, dredging, 20 cents per c. y., s. m., **93**, 3084.
**1895.** J. B. Donnelly, removal of and replacing portion of pier, approximate total of bid, $10,921, **95**, 3112.
**1899.** E. J. Hingston, dredging (circular letter), 18 cents per c. y., **99**, 3065. J. B. Donnelly, construction of part of west breakwater (dredging 30 cents per c. y.; timber, stone, iron work, and mattress work), $24,428, **99**, 3067.

**Documents.** (Not printed in reports.)
Report of Maj. Graham for 1857, S. Doc. 42, 35th Cong., 1st sess.
Report of Lt. Col. Cram for 1864, and all reports of early operations.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **66**, 5, ii, 41, iii, 4, iv, 15, 19; **67**, 30, 220; **68**, 41; **69**, 137; **70**, 48; **71**, 47; **72**, 44, 230; **73**, 44, 339; **74**, 51; **75**, 56; **76**, 108; **77**, 115; **78**, 130; **79**, 173; **80**, 227; **81**, 311; **82**, 305; **83**, 313; **84**, 317; **85**, 341; **86**, 336; **87**, 302; **88**, 275; **89**, 326; **90**, 295; **91**, 371; **92**, 350; **93**, 401; **94**, 376; **95**, 410; **96**, 365; **97**, 459; **98**, 449; **99**, 532, **1900**, 598.

BOARD OF ENGINEERS. Date unknown; approved the plan suggested by Col. H. Bache in 1853 for extension of east pier to length of west pier, **66**, iv, 15. Convened February 26, 1872, at Buffalo. Recommended (Lt. Col. Woodruff not concurring) extension of west pier 600 f. and east pier 300 f. Estimated cost, $53,000, **72**, 243, 244. (Lt. Col. Woodruff, Majs. McFarland and Wilson, and Capts. Farquhar and Gillespie.)

ENGINEERS IN CHARGE:
Maj. J. D. Graham, T. E., 1857. Report, S. Doc. 42, 35th Cong., 1st sess.
Lt. Col. T. J. Cram, 1864–67. Reports, (Col. ) **66**, 21, iv, 16; **67**, 141, 217, 220.
Maj. W. McFarland, 1868–70, **68**, 158; **69**, 137; **70**, 178.
Capt. G. L. Gillespie, 1871–72; **71**, 189. Reports, **71**, 195; **72**, 230, 240.
Lt. Col. I. C. Woodruff. Report, **72**, 241, 243.
Maj. F. Harwood, 1873–74. Reports, **73**, 338; **74**, 222.
Lt. Col. C. E. Blunt, 1874–77; **74**, 215. Reports, **75**, 310, 312; **76**, ii, 561; **77**, 965.
Maj. W. McFarland, 1878. Report, **78**, 1263.
Maj. J. M. Wilson, 1878–83. Reports, **79**, 1698; **80**, 2147; **81**, 2320; **82**, 2407.
Maj. L. C. Overman, 1883–92. Reports, **83**, 1914; **84**, 2108; **85**, 2235; **86**, 1868; **87**, 2324; **88**, 2011; **89**, 2326; **90**, 2781; **91**, 2859.
Lt. Col. J. A. Smith, 1892–. Reports, **92**, 2506; **93**, 3081; **94**, 2414; **95**, 3107; **96**, 2953; (Col.) **97**, 3082; **98**, 2676; **99**, 3064; **1900**, 4070.

ASSISTANTS:
Capt. F. U. Farquhar, **67**, 217.
Capt. M. B. Adams, in immediate charge, **75**, 292.
F. S. Burrowes. Report, **94**, 2416.

## FAIRPORT HARBOR (Grand River Harbor), OHIO—Continued.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Graham, 1857, extension of pier 716 f., $32,819.39; tearing away old work and repairs, $6,179.55; dredging, etc., $2,500; total, $41,498.94, S. Doc. 42, 35th Cong., 1st sess.

By Lt. Col. Cram, 1864, extension of east pier 510 f., $24,072, **66**, 22, 24, iv, 73.

By Col. Cram, 1867, extension of east pier 310 f., $21,631, **67**, 141.

By Capt. Gillespie, 1872, extension of west pier 360 f., $21,716; extension of west pier 490 f. and of east pier 130 f., $37,000, **72**, 241.

By Board of Engineers, 1872, extension of west pier 600 f. and east pier 300 f., $53,000, **72**, 243.

By Maj. Harwood, 1873, entire completion, $30,000, **73**, 39.

By Lt. Col. Blunt, 1875, three plans for converting the old bed of the river into a harbor of refuge: (1) $6,778,000; (2) $4,413,000; (3) $2,295,000, and for ice harbor, $350,000, **75**, 313.

By Maj. Wilson, 1879, completion of existing project, $5,000, **79**, 1699.

**Legal proceedings.**

In 1889 the east pier was licensed by the Secretary of War to a corporation for one year, at an annual rental of $2,000, which was paid for the first year, but after the first year the corporation still retained and made use of the pier, refusing, however, to pay anything as rental. In 1891 the matter was referred to the Department of Justice, but in 1894 nothing had been done in the matter, **94**, 2415, 2418; **95**, 3111.

In 1894 the American Transportation Co. made a claim for an amount which had been forfeited under the terms of a contract for dredging in 1890–91. **95**, 3109.

In 1895 information was given to the U. S. district attorney that a dock company was engaged in placing permanent obstructions in the water of Grand River beyond the dock line, **95**, 3111.

**Operations.**

**1865.** Piers repaired, **66**, 12, 21.

**1866–67.** Extension and repairs of piers, **67**, 141.

**1867–68.** Repairs to old piers; extension of east pier; 4 cribs placed in position, **68**, 41.

**1868–69.** Six cribs placed and superstructure built, completing the east pier extension, **69**, 137.

**1871–72.** Piers repaired by day labor, **72**, 230.

**1872–73.** Extension of east pier 240 f.; 120 f. of superstructure built on it; extension of west pier 450 f., and 96 f. of superstructure built; repairs made and removal of wreck, **73**, 44.

**1873–74.** Extension of piers by contract, **75**, 310.

**1874–75.** Completion of both piers as projected; west pier repaired, **75**, 56.

**1875–76.** Extension of west pier 136 f. by contract, **76**, ii, 562.

**1876–77.** Piling at inner ends of piers and catch-sand fence built; piers repaired, **77**, 965, 966.

**1879–80.** 575 l. f. east pier superstructure rebuilt, 6,975 c. y. dredged from bar, and repairs to piers, **80**, 2153.

**1881–82.** 376 l. f. east pier superstructure rebuilt and extensive repairs made; 10,000 c. y. dredged from channel through bar, **82**, 2407.

**1882–83.** Four cribs completed, **83**, 1914.

**1883–84.** West pier extended 160 f. and settled part rebuilt; minor repairs to east pier, **84**, 2109.

**1884–85.** 10,082 c. y. dredged, **85**, 2236.

**1885–86.** East pier extended 80 f., west pier superstructure repaired, **86**, 1869.

**1886–87.** 4,930 c. y. dredged from channel through bar and between the piers; repairs made to piers; extension of east pier in progress, **87**, 2324.

**1887–88.** East pier extended 200 f. under contract, **88**, 2012.

**1888–89.** 8,240 c. y. dredged from between the piers; west pier extension begun, **89**, 2326.

**1889–90.** West pier extension completed; 3,000 c. y. dredged, **90**, 2781.

**1890–91.** 42,001 c. y. dredged; 3 cribs sunk in extension of west pier, **91**, 2860.

**1891–92.** 51,353 c. y. dredged, **92**, 2506.

**1892–93.** 10,562 c. y. dredged, and extension of east and west piers in progress, **93**, 3082.

**1893–94.** 2,263 c. y. dredged, **94**, 2414, and in connection with previous year the extension of the east pier 120 l. f. and the west pier 160 l. f. was completed, **94**, 2415.

**1894–95.** Part of the west pier removed and rebuilt, **95**, 3108, 7,041 c. y. dredged, **95**, 3109, and harbor lines established, **95**, 3111.

**1895–96.** 7,968 c. y. dredged, **96**, 2955.

**1896–97.** 56,995 c. y. dredged, **97**, 3083.

**1897–98.** Dredging in progress, **98**, 2678.

**1898–99.** Soundings made through ice for breakwater foundations; 9,966 c. y. dredged, **99**, 3065.

**1899–1900.** Construction of part of west breakwater in progress; about 40,000 c. y. dredged, **1900**, 4072.

## FAIRPORT HARBOR (Grand River Harbor), OHIO—Continued.

**Physical characteristics.**

Description of, **93**, 3082; **94**, 2415; **95**, 3108; **96**, 2955, 2956; **98**, 2677.

The harbor exceptionally subject to the formation of sand bars, **95**, 3108; **99**, 3066.

The harbor simply a part of Grand River, Ohio, near its mouth where it flows into Lake Erie, **96**, 2956.

**Plans.** (See *Estimates* and *Projects.*)

By Col. Cram, 1866, to abandon a portion of west pier and rebuild it parallel to the east pier, and for dredging through outer bar, **66**, 21.

By Capt. Gillespie, 1872, removal of flare in west pier, and extension of 360 f.; estimate, $21,716. Extension of west pier parallel to east pier, and extension of east pier; total extension, 460 f.; estimate, $27,000. Total extension of piers, 770 f.; inclining west pier extension toward east pier; estimate, $46,000. Removal of superstructure of flare of west pier, and extension of both piers to the general line of the ice bar; total extension, 620 f.; estimate, $37,000. **72**, 240, 241.

By Lt. Col. Blunt, 1875, converting the old bed of the river into a harbor of refuge by dredging a basin with an area of 492 acres, construction of piers, etc.; estimate, $6,778,000. For a basin of smaller dimension, piers, etc.; estimate, $4,413,000; or for still smaller basin, piers, etc.; estimate, $2,295,000. For an ice harbor by dredging, revetments, etc.; estimate, $350,000. **75**, 313.

**Private (corporate) work.**

Dredging by Painesville & Youngstown R. R. Co., **80**, 2153.

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Cram, 1864, repairs of old piers, **66**, 13.

By Col. Cram, 1867, extension of east pier 510 f., **67**, 221.

By Board of Engineers, 1872, removal of superstructure from flare of west pier and extension of both piers an aggregate of 900 f.; estimate, $53,000, **72**, 230, 243, 244.

By Maj. Harwood, 1874, protection of the inner ends of the piers, **74**, 222.

By Lt. Col. Blunt, 1875, extension of west pier 150 f., **75**, 311.

By Maj. Wilson, 1879, removal of superstructure, **79**, 173, 1698.

By Capt. Maurice, 1825, removal of bar at mouth of river with parallel piers 200 f. apart, extending out to a depth of 10 f.; the west pier to be longer than the east and to flare to the westward; estimate, $26,997.81, **80**, 2147. For extension and changes in original project, see history of work, **80**, 2147.

In 1879 the west pier had reached a total length of about 1,060 f., and the east pier 1,250, **81**, 2320.

By Maj. Wilson, 1880, extension of the west pier 500 f. and east pier 600 f., renewal of superstructure, and dredging in channel to maintain a depth of 15 f. at harbor entrance; estimate, $80,300, **80**, 2153. Increased in 1882, to $93,000, **82**, 2407; **87**, 2325.

In 1890 Maj. Overman proposed the formation of an increased depth of 18 f. by extension of both piers lakeward 600 f., with dredging between the piers, beyond their ends, and in Grand River; estimate, $114,100, **90**, 2782.

In 1892–93 Lt. Col. Smith revised the cost of completing two parallel piers in accordance with the existing project, making the total cost of their construction $212,000, **93**, 3081.

By Lt. Col. Smith in 1895 for removing nearly 138 l. f. of the west pier and replacing the removed portion with new, at a cost of $10,921, **95**, 3108.

By Lt. Col. Smith in 1896 for two breakwaters converging toward the lake, with a space of about 500 f. between outer ends to form an entrance, and the dredging of an area between them to a depth of 20 f., estimate, $510,000; the east breakwater to be 1,350 l. f. and the west breakwater 2,050 l. f. long, **96**, 2956.

By Lt. Col. Smith in 1896 for expending only such part, not exceeding $10,000, of the appropriation of 1896, for the maintenance of the channel as might be required, the balance to be held for further appropriations before beginning the construction of the breakwaters as proposed above, **97**, 3084.

In 1900 Col. Smith estimated that because of the advance in the price of materials and necessary changes in construction methods it would cost $480,000 to complete project, **1900**, 4071; and for that year also $184,825 would be required for maintenance and repair, **1900**, 4073.

**Surveys.**

By W. T. Casgrain, 1865, under direction of Col. Raynolds, **66**, 25; **69**, 138.

By Col. Cram. Report, **67**, 217.

By Capt. Gillespie. Report, **72**, 240.

By Lt. Col. Blunt. Report, **75**, 312.

By Maj. Wilson. Report, **79**, 173, 1693.

Examination of harbor, 1881, **81**, 2320.

Survey of harbor, 1882, **82**, 2407.

Hydrographic survey made in 1892, covering the channel and the bar outside to a depth of 18 f. in the lake, by Lt. Col. Smith, **93**, 3081.

In 1893 an examination and survey of the east pier occupied by a private corporation made under direction of Lt. Col. Smith, **94**, 2415.

## FAIRPORT HARBOR (Grand River Harbor), OHIO—Continued.

Examination of the piers made in 1894, **95**, 3108, and surveys of the bar were made in 1894–95 by Lt. Col. Smith, **95**, 3109.

Resurvey of the port with an estimate of the cost of improvement that might be recommended was ordered by resolution of Congress Mar. 24, 1896, and a report was submitted in 1896 by Lt. Col. Smith, **96**, 2956.

Examination of the bar made in 1896–97 by Lt. Col. Smith, **97**, 3083.

Survey and map of the channel and bar made in 1897 by Col. Smith, **98**, 2677.

MAPS:

Of Northern and Northwestern Lakes, showing location of harbor, **66**, i.

Of the harbor, by Col. Cram, in 1865, **66**, i; **81**, 2320; **91**, 2861; **94**, 2418; **95**, 3112.

## FAIRY LAKE, TEX. AND LA. (See *Cypress Bayou.*)

## FALAYA. (*See Bogue Falia, Chefuncte River, La.*)

## FALKNERS ISLAND, CONN.

**Commerce.**

Necessity for harbor of refuge, **85**, 708.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 96.

ENGINEER IN CHARGE. Lt. Col. W. McFarland. Report, **85**, 707.

**Physical characteristics.**

Locality described, **85**, 707.

**Plans.**

By Lt. Col. McFarland, 1884, for two breakwaters, each about 600 y. long, covering an anchorage area of 120 acres, with a depth of 15 f. Estimate, $700,000. **85**, 708, 709.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of Lt. Col. McFarland, **85**, 707.

## FALL RIVER HARBOR (Mount Hope Bay), MASS. (See *Taunton River, Mass.*)

**Appropriations.**

| | | |
|---|---|---|
| 1874, | $10,000, | **74**, 98. |
| 1875, | 10,000, | **75**, 107. |
| 1876, | 10,000, | **76**, 49. |
| 1899, | 20,000, | **99**, 1131. |
| Total, | 50,000 | |

**Commerce.**

Important, **74**, ii, 285.

Commercial importance of Fall River, **78**, 227.

Description of, **95**, 728.

**Contracts.**

**1874.** Morris & Cummings,[a] rock removal, **75**, ii, 282.

**1875.** Curtis, Fobes & Co., dredging, 21,222 c. y., **75**, ii, 283.

**1877.** J. H. Fenner, dredging, 12,857 c. y., rock removal, **77**, 198.

**1899.** P. Sanford Ross, incorporated, dredging, 9 cents per c. y., **99**, 1132.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 93; **74**, 98, 103; **75**, 107; **76**, 49; **77**, 43; **78**, 47; **95**, 71; **97**, 81; **99**, 91; **1900**, 104.

ENGINEERS IN CHARGE:

Maj. G. K. Warren, 1873–78. Reports, **74**, ii, 225, 284; **75**, ii, 282; **76**, 206; **77**, 198; **78**, 227.

Capt. W. H. Bixby, 1895. Report, **95**, 727.

Maj. D. W. Lockwood, 1896–. Reports, **97**, 931; **99**, 1130; **1900**, 1263.

ASSISTANTS:

J. P. Cotton. Report, **74**, ii, 284.

H. A. Bentley, **78**, 228.

E. Parrish. Report, **97**, 934.

**Operations.**

**1874–75.** 1,047¾ tons large bowlders, 364 tons small bowlders and gravel, excavated, **75**, 107, ii, 282.

**1875–76.** 136.53 c. y. bowlders, 21,222.19 c. y. fine material, excavated, **76**, 206.

**1877–78.** 12,857 c. y. dredged, **78**, 47. Improvement completed at a cost less than the original estimate, **78**, 228.

**1899–1900.** 193,579 c. y. mud and sand removed, **1900**, 1264.

**Physical characteristics.**

Obstructions: bowlders and bars, **74**, ii, 285.

Tides, **74**, ii, 285; **78**, 228.

Description of, **95**, 728.

**Projects.**

By Maj. Warren, removal of bowlders; for dredging channel 50 f. from the wharves to a width of 100 f. and depth of 12 f.; also for placing dolphins to mark channel, estimate, $45,000, **74**, ii, 285, 286. Project completed at cost of $30,000, **78**, 228.

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[a] Contract abandoned, **75**, ii, 282.

## FALL RIVER HARBOR (Mount Hope Bay), MASS.—Continued.

By Maj. Lockwood, 1897, for channel 300 f. wide and 25 f. deep at m. l. tide, along the city front between the Old Colony wharf and deep water at upper end of city front; estimate, $58,060.47, **99**, 1131.

**Surveys.**

1873. By J. P. Cotton. Report, **74**, ii, 284.

Examination ordered by act of August 17, 1894, made by Capt. Bixby, 1895 (report favorable), **95**, 727.

Survey ordered by act of June 3, 1896, made by Maj. Lockwood, 1897 (see *Projects*), **97**, 932.

Harbor line survey, 1899, made under direction of Maj. Lockwood, **1900**, 1264.

## FALLS OF ST. ANTHONY, MISSISSIPPI RIVER. (See *Mississippi River, preservation of the Falls of St. Anthony; Transportation routes to the seaboard.*)

## FALLS OF THE OHIO RIVER. (See *Ohio River, Falls of.*)

## FALMOUTH HARBOR, MASS.

**Engineers.**

Chief of Engineers. Report, **87**, 43.

Engineer in Charge. Maj. W. R. Livermore, 1886. Report, **87**, 567.

**Physical characteristics.**

Description, **87**, 567.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Maj. Livermore (report unfavorable), **87**, 567.

## FALSE PRESQUE ISLE HARBOR, LAKE HURON, MICH. (Harbor of Refuge).

**Engineers.**

Chief of Engineers. Report, **89**, 319.

Engineer in Charge. Col. O. M. Poe, 1888. Report, **89**, 2276.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Col. Poe (report unfavorable), **89**, 2276.

## FARM CREEK, ILL.

**Commerce.**

Unimportant, **87**, 2171.

**Engineers.**

Chief of Engineers. Report, **87**, 277.

Engineer in Charge. Maj. T. H. Handbury, 1886. Report, **87**, 2171.

**Physical characteristics.**

Description, **87**, 2171.

**Surveys.**

Examination, with a view to changing course, ordered by act of Aug. 5, 1886, made, 1886, under direction of Maj. Handbury (report unfavorable), **87**, 2171.

## FARMINGTON CANAL, CONN.[a]

## FAR ROCKAWAY AND INWOOD, N. Y.

**Commerce.**

Description of; estimated at $402,000 annually, **97**, 1171.

**Engineers.**

Chief of Engineers. Report, **97**, 140.

Engineer in Charge. Maj. H. M. Adams, 1896–97. Report, **97**, 1170.

**Physical characteristics.**

Description of; Far Rockaway and Inwood adjoining villages on the east end of Jamaica Bay, **97**, 1171.

**Surveys.**

Examination of the channels at Far Rockaway and Inwood ordered by act of June 3, 1896, made, 1897, by Maj. Adams (report unfavorable), **97**, 1171.

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[a] Examination—Report (indefinite) Jan. 22, 1830. (H. Doc. No. 55th 482, Cong., 2d sess.)

## FEATHER RIVER. (See *California Débris Commission; Sacramento and Feather rivers.*)

**Commerce.**
In 1895 there was no commerce above Marysville, **95**, 3327.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 440.
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1895. Report, **95**, 3325.

**Physical characteristics.**
Description of; river rises in the Sierra Nevada Mountains, and flows in a general southerly direction to the Sacramento River, which it joins 21 miles above the city of Sacramento, **95**, 3326.

**Surveys.**
Examination of the river above Marysville ordered by act of Aug. 17, 1894, made in the same year by Maj. Heuer (report unfavorable), **95**, 3326.

## FERNANDINA. (See *Savannah, Ga.*)

## FERNANDINA AND ST. JOHNS RIVERS, FLA. (See *St. Johns and Fernandina rivers.*)

## FERNANDINA TO NASSAU RIVERS. (See *St. Johns River, Fla.*)

## FERRY LAKE, TEX. AND LA. (See *Cypress Bayou.*)

## FIFTEEN-MILE FALLS, N. H. (See *Connecticut River.*)

**Commerce.**
Important, **71**, 861, 866.
Obstructions to commerce, **71**, 863, 864.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **70**, 31, 83; **71**, 96.
ENGINEER IN CHARGE. Lt. Col. G. Thom. Reports, **71**, 861; **72**, 957.

**Obstructions.** (See *Commerce; Physical characteristics.*)

**Physical characteristics.**
Presence of ledges and bowlders, **71**, 863, 864.

**Plans.**
By Lt. Col. Thom, for running of logs, crib work, and removing bowlders and ledges; estimate $18,000. For rafting of sawed lumber, and for running of logs, sluiceways, and crib work, and removing ledges and bowlders; estimate $25,000. **71**, 864, 865, 866. Modified by the substitution of booms for crib-work, at an estimated cost, for running logs only, of $15,000; for running logs and rafting sawed lumber, $22,000, **72**, 960.

**Private (corporate) work.**
Improvements made by private corporations at worst points by removing bowlders and by constructing slips, sluiceways, and locks at various points, **71**, 862.

**Surveys.**
Under direction of Lt. Col. Thom, 1870–71. Reports, **71**, 861; **72**, 957.

## FINHALLOWAY RIVER, FLA.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 141; **81**, 189; **82**, 185.
ENGINEER IN CHARGE. Capt. A. N. Damrell. Report, **82**, 1301.
ASSISTANT. P. Robinson. Report, **82**, 1301.

**Plans.**
By Capt. Damrell, 1881, for removing such snags and trees as might interfere with rafting logs, mouth to head of Dead River, 12 miles. Estimated cost, $500. **82**, 1302.

**Surveys.**
Ordered by act of June 14, 1880, made, 1881, under direction of Capt. Damrell, **82**, 1301.

## FISHING CREEK, N. C.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $10,000, | **91**, 1346. |
| 1892, | 5,000, | **92**, 1118. |
| 1899, | 7,750, | **99**, 1489. |
| Total, | 22,750. | |

**Commerce.**
Chiefly cotton, peanuts, and lumber exported, and fertilizers and merchandise imported, **93**, 1378.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 149;

## FISHING CREEK, N. C.—Continued.

**90**, 133; **91**, 156; **92**, 157; **93**, 170; **94**, 156; **95**, 178, **96**, 161; **97**, 200; **98**, 202; **99**, 234; **1900**, 266.

Engineers in Charge:

Capt. W. H. Bixby, 1888–92. Reports, **90**, 1179, 1181; **91**, 1345.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1117; **93**, 1377; **94**, 1018; **95**, 1311.

Lt. Col. D. W. Heap, 1896. Report, **96**, 1100.

Capt. W. E. Craighill, 1897–98. Reports, **97**, 1387; **98**, 1239.

Capt. E. W. Van C. Lucas, 1899—. Reports, **99**, 1489; **1900**, 1796.

**Obstructions.**

Bridges obstructing navigation, **91**, 1346.

At an inspection, 1895–96, all bridges below the Wilmington & Weldon R. R. bridge, 8 in all, were decided to be unreasonable obstructions to navigation. Work was commenced by the proper parties to alter the bridges as required in 1896, and all alterations completed satisfactorily in that year, **96**, 1100; **97**, 1387.

**Operations.**

**1890–91.** Commencement of operations postponed pending alteration of bridges spanning the creek, **91**, 1345; **92**, 1117.

**1896–97.** 4,085 large snags, 456 stumps, 256 logs, 1,044 trees, and 50 cords of small snags were removed from the stream, and 634 trees were hauled back, 178 trees trimmed, and 117 cords of brush cut from the banks, **97**, 1387.

**1897–98.** 6,653 large snags, 346 stumps, 560 trees, and 45 cords of small snags were removed from the stream, and 623 trees were hauled back, 91 trees were trimmed, and 134 cords of brush cut on the banks, **98**, 1239.

**1898–99.** 2,096 large snags, 198 stumps, 330 trees, 55 logs and 10 cords small snags were removed from the stream, 260 trees and 8 stumps hauled back, 44 trees trimmed, and 64 cords of brush cut from bank, **99**, 1489.

**1899–1900.** 31 logs, 3,386 snags, 275 stumps, and 948 trees removed from channel, 81 cords brush and 456 trees from the banks, and 65 trees trimmed, **1900**, 1797.

**Physical characteristics.**

Description of, **90**, 1180; **93**, 1377.

**Projects.**

By Capt. Bixby, 1889, mouth up to Bellamy's mill, removal of logs, snags, and similar obstructions, estimate $25,000, **90**, 1181; **91**, 1345.

In 1896, by Lt. Col. Heap, the project of 1889 was modified to provide for clearing out the natural obstructions up to the Wilmington & Weldon R. R. bridge at an estimated cost of $22,750, and for the maintenance of the improvement at an estimated cost of $2,000 annually, **96**, 1100.

**Surveys.**

Ordered by act of Aug. 11, 1888; made, 1889, under direction of Capt. Bixby, **90**, 1179.

Maps. **93**, 1378.

**FISHING PLACE COVE.** (See *Sakonnet Point, R. I.*)

**FISH ROCK.** (See *Fort Ross, Cal.*)

**FISKS MILL.** (See *Fort Ross, Cal.*)

**FIVEMILE CREEK, ALA.** (See *Black Warrior River* and *Fivemile Creek, Ala.*)

## FIVEMILE RIVER HARBOR, CONN.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $5,000, | **85**, | 52. |
| 1890, | 5,000, | **90**, | 647. |
| 1892, | 5,000, | **92**, | 698. |
| 1894, | 2,500, | **95**, | 810. |
| 1896, | 2,500, | **96**, | 717. |
| 1899, | 2,500, | **99**, | 1181. |
| Total, | 22,500 | | |

**Commerce.**

Present and prospective, **87**, 640, 641.

Description of, **96**, 716.

**Contracts.**

**1889.** R. Parrott, hire of dredging plant, $8.50 per hour, **89**, 711.

**1891.** G. B. Beardsley, dredging, 14.6 cents per c. y., **91**, 794.

**1892.** A. J. Beardsley, dredging, 14½ cents per c. y., s. m., $2,900, **93**, 953.

**1894.** J. H. Fenner, dredging, 14,815 c. y., at 13½ cents per c. y., **95**, 811.

**1896.** G. B. Beardsley, dredging, 8½ cents per c. y., $1,700, **97**, 966; 4,453 c. y., at 14.3 cents per c. y., **98**, 968.

**1899.** Hartford Dredging Co., dredging, 18 cents per c. y., $2,399.94, **99**, 1181.

**Engineers.**

Chief of Engineers. Reports, **87**, 56; **88**, 52; **89**, 65; **90**, 58; **91**, 72; **92**, 76;

## FIVEMILE RIVER HARBOR, CONN.—Continued.

**93**, 83; **94**, 74; **95**, 84; **96**, 80; **97**, 100; **98**, 105; **99**, 119; **1900**, 135.

Engineers in Charge:

Lt. Col. D. C. Houston, 1886–92. Reports, **87**, 639; (Col.) **89**, 710; **90**, 646; **91**, 792; **92**, 697.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 952; **94**, 674; (Col.) **95**, 809.

Maj. H. M. Adams, 1896. Report, **96**, 716.

Maj. S. S. Leach, 1897–. Reports, **97**, 965; **98**, 968; **99**, 1180; **1900**, 1346.

**Operations.**

**1888–89.** 10,976 c. y. dredged, **89**, 711.

**1889–90.** 11,962 c. y. dredged, **90**, 647.

**1891–92.** 30,000 c. y. dredged, **92**, 698.

**1893–94.** 30,000 c. y. dredged, **94**, 675.

**1895–96.** 15,014 c. y. dredged, **96**, 717.

**1897–98.** 21,956 c. y. dredged, **98**, 968.

**Physical characteristics.**

Description of, **87**, 639; **89**, 710; **93**, 952.

**Private work.**

Channel on east side of river dredged to the docks by the dock owners, **94**, 675.

**Projects.**

By Col. Houston, 1886, for deepening the harbor and approaches by a channel 100 f. wide, 8 f. deep at m. l. w., and 6,000 f. long; estimated first cost, $25,000, with $1,000 for annual maintenance, **87**, 641; **89**, 710; **92**, 697. Cost estimated by Col. Robert, 1894, at $45,000, **94**, 676.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. Houston, **87**, 639.

Maps. **94**, 676.

## FLAG RIVER. (See *Iron River, Wis.; Port Wing, Wis.*)

## FLATBEACH OR TUCKERS ISLAND, N. J. (to preserve anchorage).[a]

**Appropriation.**

Mar. 2, 1829, $100.

## FLATHEAD RIVER AND PEND D'OREILLE RIVER, MONT.

(See *Pend d' Oreille River.*)

**Appropriation.**

1896, $10,000, **96**, 3391.

**Commerce.**

Description of. On account of the difficulties in the way of making a commercial water highway down the river the stream in 1895 was not thought worthy of improvement by the Government, but one portion of the river, between Demersville and the lake, was thought worthy of improvement to the extent of the removal of snags. **95**, 3481.

**Engineers.**

Chief of Engineers. Reports, **95**, 458; **96**, 417; **97**, 522; **98**, 522; **99**, 614; **1900**, 692.

Engineers in Charge:

Capt. T. W. Symons, 1895. Report, **95**, 3480.

Capt. H. Taylor, 1896–. Reports, **96**, 3390; **97**, 3468; **98**, 3081; **99**, 3280; **1900**, 4501.

**Operations.**

**1897–98.** 846 snags removed, **98**, 3081.

**1898–99.** Over 1,000 snags, etc., removed, **99**, 3280.

**Physical characteristics.**

Description of, **95**, 3480.

The name "Flathead" applies to the river above Flathead Lake and below the lake to a point where it unites with the Missoula, from which point it becomes the Clarke Fork of the Columbia, or Pend d'Oreille River, **95**, 3480.

Columbia Falls is a very small town on the river a little below where the North, Middle, and South forks unite, **95**, 3481.

A portion of the river passes through a rocky canyon in which there are four groups of falls, making a total fall of 220 f., passage of which must be provided for at a great cost in order to give continuous navigation of the river, **95**, 3482.

**Projects.**

By Capt. Symons, 1895, for removal of snags from the river between Demersville and Flathead Lake at an uncertain cost, **95**, 3483; **96**, 3390.

**Surveys.**

Examination of the river from Columbia Falls, Mont., to its mouth at Flathead Lake, and from its outlet on the south at Flathead Lake to the Clarkes Fork, Columbia River, ordered by act of Aug. 17, 1894; made, 1895, by Capt. Symons (report favorable to limited improvement, see *Projects*), **95**, 3480.

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[a] Survey—Report Mar. 6, 1830; estimate $5,605.40. (H. Doc. No. 482, 55th Cong., 2d sess.)

**FLINT RIVER, GA., ETC.**[a] (See *Chattahoochee and Flint rivers; Choctawhatchee River; Savannah River, Ga.; Shiawassee River, Mich.*)

**FLORIDA.** (See *Mississippi River.*)

## FLORIDA AND LOUISIANA WATERS (removing the water hyacinth from).

| Part. | Appropriations. |
|---|---|
| A.—Florida and Louisiana waters | $5,000 |
| B.—Florida waters | 36,000 |
| C.—Louisiana waters | 36,000 |
| Total | 77,000 |

### Part A.—Florida and Louisiana waters (removing the water hyacinth from).

**Appropriation.**
1897, $5,000, act of June 4.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **97**, 25; **98**, 35; **99**, 40, 276, 277.

BOARD OF ENGINEERS. Convened at St. Augustine, Fla., Sept. 5, 1897, by S. O., No. 18, dated June 19, 1897, to investigate the water hyacinth question in the States of Florida and Louisiana; report, **99**, 1615. (Lt. Col. W. H. H. Benyaurd and Maj. J. B. Quinn.)

ASSISTANT. J. W. Sackett. Report, **99**, 1621.

**Obstructions.**
Lower bridge trusses prevent a free flow of the masses of hyacinths, **99**, 1619.

**Operations.**
Experiments made, 1898, to discover the action of various chemicals on the life of the plant, **99**, 1620.

**Physical characteristics.**
Description of plant and its effects, **99**, 1616.

**Projects.**
Board of Engineers, 1897, estimated, 1898, it would cost $36,000 to remove the water hyacinth from the navigable waters of Florida and Louisiana, and that additional annual appropriation would be needed to keep the waters free from this plant, **99**, 1621.

**Surveys.**
Investigation of the hyacinth question in the States of Florida and Louisiana ordered by act of June 4, 1897 (see *Board of Engineers; Projects*), **99**, 1615.

### Part B.—Florida waters (removing the water hyacinth from).

**Appropriation.**
1899, $36,000, **99**, 1612.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **97**, 25; **98**, 35; **99**, 276; **1900**, 315.

ENGINEERS IN CHARGE:
Capt. C. H. McKinstry, 1899–. Reports, **99**, 1612; **1900**, 1985.
Capt. T. H. Rees, 1900. Report, **1900**, 1985.

**Projects.** (See Part C.)
By Board of Engineers, 1897, for removing plant with; cost, boats, $25,000; log booms, $1,000, and operating expenses, $10,000, **99**, 1621; **1900**, 1985.

### Part C.—Louisiana waters (removing water hyacinths from).

**Appropriation.**
1899, $36,000, **99**, 1855.

**Contracts.**
**1899.** E. E. Wood, stern-wheel steamboat, $8,000; Johnson Iron Works, Limited, furnishing and installing machinery on boat, $4,750; F. B. Williams, constructing log boom at mouth of Bayou Teche, $950. **1900**, 2271.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **97**, 25; **98**, 35; **99**, 332; **1900**, 377.

ENGINEERS IN CHARGE:
Maj. J. B. Quinn, 1899. Report, **99**, 1855.
Maj. H. M. Adams, 1900. Report, **1900**, 2270.

**Projects.**
By Board of Engineers, 1897, for expending $25,000 for boat and machinery suitable for raising the plants and crushing them; $1,000 for constructing log booms across the mouths of small streams to prevent the drift of the hyacinths into the larger rivers and bayous, and $10,000 for conducting operations, **1900**, 2270.

Subproject, 1899, provided for constructing a boom at the mouth of Bayou Teche, La. (one of the principal navigable streams affected by the hyacinths), with a gate arranged to allow the hyacinths to float out with outgoing tides and to prevent their return, **1900**, 2270.

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[a] Survey—Report July 4, 1853; estimate, $12,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## FLORIDA CANAL.[a] (See *Mississippi River to the Atlantic Ocean.*)

## FLORIDA RIVER AND HARBOR IMPROVEMENTS.

**Appropriation.**
1899, $35,000, **99**, 1613.

**Engineers.**
Chief of Engineers. Reports, **99**, 277; **1900**, 315.

Engineers in Charge:
Capt. C. H. McKinstry, 1899. Report, **99**, 1613.
Capt. T. H. Rees, 1900. Report, **1900**, 1985.

**Projects.**
Purchase or construction of a suitable dredge, with snagging outfit, to be used in Florida waters, ordered by act of Mar. 3, 1899; estimated cost, $50,000 to $55,000, **99**, 1613; **1900**, 1985, 1986.
Description of boat, **99**, 1615.

## FLUSHING BAY, N. Y. (See *Newtown Creek, N. Y.*)

**Appropriations.**
1879, $20,000, **79**, 62.
1880, 15,000, **80**, 509.
1881, 10,000, **81**, 633.
1882, 5,000, **82**, 659.
1884, 10,000, **84**, 725.
1886, 10,000, **86**, 662.
1888, 15,000, **88**, 582.
1890, 20,000, **90**, 666.
1892, 10,000, **92**, 724.
1894, 4,000, **95**, 843.
1896, 4,000, **96**, 744.

Total, 123,000

**Commerce.**
Benefit of improvement to commerce, **78**, 430; **79**, 387.
Opposition of Newtown citizens to dike construction, **80**, 508.
No local commerce to be benefited by the construction of a channel between the bay and Newtown Creek, and the use of the channel by other commerce uncertain, **97**, 1160.

**Contracts.**
**1879.** H. Du Bois & Sons, pile-dike construction, **80**, 509.
**1880.** W. Flannery, dredging, 17 cents per c. y., **81**, 633.
**1881.** C. M. Pratt, dredging, 24 cents per c. y., **82**, 659.
**1882.** H. N. & A. J. Beardsley, dredging, 19½ cents per c. y., **83**, 560.
**1884.** H. Du Bois's Sons, dredging, 18 cents per c. y., **85**, 667.
**1886.** P. S. Ross, dredging, 17.7 cents per c. y., **87**, 636.
**1889.** J. & A. DuBois, pile-dike construction, at $45.09¼ per 10 l. f., dredging, 20 cents per c. y., **89**, 732.
**1891.** C. & H. E. DuBois, dredging, 18 cents per c. y., **91**, 823.
**1892.** C. & H. E. DuBois, dredging, 28 cents per c. y., s. m. ($14,000), **93**, 983.
**1895.** J. H. Fenner, dredging, 18 cents per c. y., s. m. ($3,500), **95**, 844.
**1897.** W. W. Du Bois, dredging, 20,588 c. y., 17 cents per c. y., s. m., **97**, 1107.

**Engineers.**
Chief of Engineers. Reports, **78**, 58; **79**, 62, 66; **80**, 82; **81**, 100; **82**, 101; **83**, 101; **84**, 106; **85**, 90; **86**, 91; **87**, 55; **88**, 56; **89**, 69; **90**, 62; **91**, 77; **92**, 82; **93**, 89; **94**, 80; **95**, 91; **96**, 87; **97**, 123, 139; **98**, 118; **99**, 133; **1900**, 151.

Engineers in Charge:
Lt. Col. J. Newton, 1878–83. Reports, **78**, 430; **79**, 385, 386; (Col.) **80**, 508; **81**, 631; **82**, 657.
Lt. Col. G. L. Gillespie, 1883–85. Reports, **83**, 559; **84**, 724.
Lt. Col. W. McFarland, 1885–86. Report, **85**, 666.
Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 661; **87**, 634; (Col.) **88**, 581; **89**, 730; **90**, 664; **91**, 822; **92**, 722.
Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 980; **94**, 703; (Col.) **95**, 842.
Maj. H. M. Adams, 1896–98. Reports, **96**, 742; **97**, 1106, 1159; **98**, 1008.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1227.
Maj. E. H. Ruffner, 1900–. Report, **1900**, 1401.
Assistant. R. H. Talcott, **79**, 386. Report, **79**, 387.

**Operations.**
**1879–80.** 3,057 l. f. pile dike built, **80**, 508.
**1880–81.** Channel 6,000 f. long and 65 f. wide dredged from 6-f. depth on East River side to corresponding depth at Flushing, **81**, 632.
**1881–82.** 36,000 c. y. dredged, **82**, 657.
**1882–83.** 31,959 c. y. dredged, **83**, 560.
**1884–85.** 44,633 c. y. dredged, **85**, 667.
**1886–87.** 26,630 c. y. dredged from channel leading up the bay and creek to Flushing; history of past operations, **87**, 635.
**1887–88.** 23,630 c. y. dredged from channel and shoals, **88**, 581.
**1888–89.** 375 piles driven, **89**, 731.
**1889–90.** 1,606 l. f. of dike built, and 15,063 c. y. dredged, **90**, 665.

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[a] Surveys.—Reports, Feb. 19, 1829; Mar. 6, 1832, and May 1, 1855. (H. Doc. No. 482, 55th Cong., 2d sess.)

## FLUSHING BAY, N. Y.—Continued.

**1890-91.** 4,515 c. y. riprap stone placed upon the dike, **91**, 823.

**1891-92.** 73,849 c. y. dredged, **92**, 723.

**1892-93.** 31,378 c. y., s. m., dredged, **93**, 981.

**1895-96.** 19,435 c. y., s. m., dredged, **96**, 743.

**1896-97.** 20,494 c. y., s. m., dredged, **97**, 1106.

**Physical characteristics.**

Description of, **78**, 430; **79**, 387; **97**, 1159.

Description of the bay; rise of tide, **88**, 541.

Flushing Bay and Newtown Creeks separated by 4 miles of upland, **97**, 1159.

**Plans.** (See *Projects.*)

By Lt. Col. Newton, 1878, dredging a channel 100 f. wide, 3 f. deep, and 1 mile in length; estimate, $15,000; should be determined by survey, **78**, 430.

**Projects.** (See *Plans.*)

By Lt. Col. Newton, 1879, tidal basin by dredging, and an inclosing pile dike with an opening near the head of the bay, which, by filling and discharging through the main channel, would maintain a depth of 6 f. at m. l. w.; estimate, $173,500, **79**, 62, 385, 387; **86**, 661; **87**, 634; **92**, 722.

**Surveys.**

Preliminary examination, **78**, 58, 430.

By R. H. Talcott, **78**, 58; **79**, 66, 387.

Examination with a view to connecting Flushing Bay with Newtown Creek, N. Y., ordered by act of June 3, 1896, made by Maj. Adams in the same year (report unfavorable), **97**, 1159.

MAPS. **85**, 666; **89**, 732.

## FOND DU LAC RIVER, WIS.

**Commerce.**

Present and prospective commercial importance of the harbor, **90**, 2393.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 287; **90**, 259.

ENGINEER IN CHARGE. Maj. C. E. L. B. Davis, 1888. Reports, **90**, 2389, 2390.

**Plans.**

By Maj. Davis, 1889, channel 100 f. wide from the Scott Street Bridge to the north ice-house, and 150 f. wide thence to the lake, with a depth of 7 f.; estimate, $8,000, **90**, 2393.

**Surveys.**

Survey of harbor at mouth ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Davis, **90**, 2390.

## FORESTVILLE HARBOR, LAKE HURON, MICH.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 294.

ENGINEER IN CHARGE. Lt. Col. O. M. Poe, 1886. Report, **87**, 2273.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. Poe (report unfavorable—"costly"), **87**, 2273.

## FORESTVILLE HARBOR, MICH.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 319.

ENGINEER IN CHARGE. Col. O. M. Poe, 1888. Report, **89**, 2288.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Col. Poe (report unfavorable), **89**, 2282.

## FORKED DEER RIVER, TENN. (See *Obion River, Tenn.*)

| Part. | Appropriations. |
|---|---|
| A.—South Fork | $10,000 |
| B.—South, North, and Middle Forks | 23,000 |
| C.—North Fork | |
| Total | 33,000 |

## Part A.—Forked Deer River, South Fork, Tenn.

**Appropriations.**

1882, $3,000, **83**, 1155.
1884, 2,000, **84**, 1338.
1886, 5,000, **86**, 1368.

Total, 10,000

**Encroachments.**

Obstructions to navigation from bridges and dams, **87**, 1483.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 158;

## FORKED DEER RIVER, TENN.—Continued.

### Part A.—Forked Deer River, South Fork, Tenn.—Continued.

**81**, 213; **83**, 216; **84**, 226; **85**, 242; **86**, 237; **87**, 202.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1880–83. Report, **81**, 1489.

Maj. A. M. Miller, 1883–85. Reports, **83**, 1154; **84**, 1338.

Capt. E. Bergland, 1885–86. Reports, **85**, 1529; **86**, 1367.

Capt. J. H. Willard, 1886. Report, **87**, 1482.

ASSISTANTS:

Z. Harrison. Report, **81**, 1490.

J. J. Barry. Reports, **84**, 1339; **85**, 1531.

**Operations.**

**1883–84.** 17,915 logs, snags, stumps, and trees removed from river channel, **84**, 1338.

**1884–85.** 6,408 trees, logs, snags, etc., removed, **85**, 1530.

**1886–87.** 12,250 trees, logs, snags, and jams removed, **87**, 1482.

**Physical characteristics.**

Description of, **84**, 1339.

**Projects.**

By Maj. Benyaurd, 1880, removing snags and similar obstructions, Sharon to mouth, 114 miles. Estimate, $19,250. **81**, 1491; **87**, 202.

**Surveys.**

Ordered by act of June 14, 1880, made, under direction of Maj. Benyaurd, **81**, 1489.

### Part B.—Forked Deer River, Tenn.

**Appropriations.**

| | | |
|---|---|---|
| 1888, | [a] $2,500<br>[b] 4,500<br>[c] 2,500 | **89**, 1621. |
| 1890, | 2,500, | **90**, 1908. |
| 1892, | 3,000, | **92**, 1662. |
| 1896, | 6,000, | **96**, 1904, 1905. |
| 1899, | 2,000, | **99**, 2237. |
| Total, | 23,000 | |

**Commerce.**

Large expenditures not justified by commerce, and small expenditures inexpedient, **74**, 374.

Freight tariffs exorbitant, **74**, 377.

Description of, **74**, 377, 379, 380.

Description of, Middle Fork, **96**, 1902; **97**, 2220; **98**, 1874.

Difference of opinion as to benefits received, **96**, 1903; **97**, 2218.

Estimated at 50,770 tons annually, 1899, valued at $487,462.27, **1900**, 2890.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 57; **74**, 63; **88**, 183; **89**, 215; **90**, 194; **91**, 246; **92**, 239; **93**, 269; **94**, 250; **95**, 305, 310; **96**, 264, 265; **97**, 340, 341, 347; **98**, 331, 333; **99**, 396; **1900**, 453.

ENGINEERS IN CHARGE:

Maj. C. R. Suter, 1873–74. Report, **74**, 372.

Capt. J. H. Willard, 1886–94. Reports, **88**, 1369; **89**, 1621; **90**, 1906; **91**, 2012; **92**, 1660; **93**, 2054; **94**, 1519.

Capt. J. Biddle, 1895–98. Reports, **95**, 2247, 2265; **96**, 1900; **97**, 2217, 2234; **98**, 1872.

Lt. Col. M. B. Adams, 1899–. Reports, **99**, 2235; **1900**, 2889.

ASSISTANTS:

O. Leibrecht, **74**, 372. Report, **74**, 372.

B. J. Smith. Report, **95**, 2270.

**Estimates.** (See *Plans* and *Projects.*)

By O. Leibrecht, 1874, for removing obstructions and building dams, $53,190.

Amended by Maj. Suter to $71,250, **75**, 374, 379.

**Legislation.**

Tennessee declared the South Fork navigable from Yellow Bluff levee and bridge to its mouth, and repealed act making river navigable above that point, **95**, 2249.

**Obstructions.**

Obstruction of South Fork by bridges without draws, **89**, 1623.

By direction of the Secretary of War, the bridge of the Louisville and Nashville R. R. at Bells, Tenn., was changed to secure a navigable opening of 50 f. in 1896, **96**, 1903.

**Operations.**

**1888–89.** 550 snags, 1 wreck, and 92 log jams removed from the channel; 1,635 trees and snags and 2,180 sq. y. brush cleared from the banks, and 100 l. f. brush dam built on South Fork; 1,452 snags and 1 wreck removed from channel; 1,605 trees and shore snags and 9,260 sq. y. brush cleared from the banks on North Fork below Dyersburg; 79 shore snags and side jams removed; 528 trees and 500 sq. y. brush cleared from banks on main river, **89**, 1622, 1623.

**1889–90.** 274 snags and logs removed from the channel; 2,675 trees and

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[a] South Fork. [b] South Fork below Dyersburg. [c] Main river below Dyersburg.

## FORKED DEER RIVER, TENN.—Continued.

### Part B.—Forked Deer River, Tenn.—Continued.

475 sq. y. brush cleared from the banks on the main river; 362 snags and 285 shore snags and trees cleared from North Fork, completing projected improvement; no operations on South Fork, **90**, 1907.

**1891–92.** Operations confined to North Fork and main river; 660 stumps and snags and 6 log jams removed; 1,300 trees cut and topped on the banks, **92**, 1662.

**1893–94.** Some brush and willows cut and over 23,000 snags and other obstructions removed, **94**, 1522.

**1894–95.** A few obstructions removed, **95**, 2249.

**1896–97.** Over 3,000 snags, etc., and 391 cords drift removed, **97**, 2218. Over 1,000 obstructions removed from Middle Fork, **97**, 2219.

**1897–98.** Nearly 4,000 obstructions removed from Middle Fork, **98**, 1873.

**1898–99.** About 4,400 snags and other obstructions removed, **99**, 2237.

**1899–1900.** About 1,800 snags and other obstructions removed, **1900**, 2890.

**Physical characteristics.**

Description of, **74**, 370, 375, 376; **90**, 1906; **95**, 2266; **97**, 2218, 2219. High-water marks, **74**, 376. Obstructions in river, **74**, 378.

Yellow Bluff (see *Legislation*) about 4 miles from the junction of the North Fork, **95**, 2249. Dyersburg lies on the North or Middle Fork, about 8½ miles above its junction with the South Fork; thence to Obion River is 21 miles, and thence to Mississippi River 3½ miles; 33 miles in all. The slopes on this portion of the stream affected by Mississippi stages, **95**, 2266.

Elevation of extreme low-water and high-water plane, and distances from Chesapeake, Ohio and Southwestern R. R. bridge, **95**, 2274.

Discharge measurements, **95**, 2275.

**Plans.** (See *Estimates* and *Projects.*)

By O. Leibrecht, 1874, removal of obstructions to a 3 f. depth at all seasons and construction of dams at the lost and old channels, **74**, 378. Discussed by Maj. Suter, **74**, 373.

**Private (private and State) work.**

Cut-off to the Mississippi was made by private parties about 35 years ago, doing more harm than good, **74**, 378.

Tennessee appropriated $43,000 for improvements within the last twenty years; no benefit derived from this expenditure, **74**, 379.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Benyaurd, 1880, removing snags and similar obstructions, and clearing the banks of South Fork, Sharon to the mouth, 114 miles; estimate, $19,250, **81**, 1491; **87**, 202. Operations subsequently extended to Jackson, head of navigation, 81 miles above Sharon. Improvement not considered permanent, **88**, 183, 1369; **90**, 1906.

By Capt. Willard, 1887, main river, mouth to junction of the North and South forks, 29 miles, removing logs, snags, and similar obstructions; estimate, $7,000; also North Fork up to Dyersburg, 9 miles; estimate, $4,500, **87**, 1484, 1495; **89**, 1621; **90**, 1906.

In 1894 Capt. Biddle, estimated it would cost $300,000 for a system of canals and locks, cost of maintenance indefinite, for North or Middle Fork, **95**, 2269.

Congress appropriated $5,000, 1896, for improving Middle Fork, from Dyersburg to Mississippi River, by removing bars and shoals, etc., to make the stream navigable for small craft at 3 f. stage, **96**, 1904.

Lt. Col. Adams advised, 1899, treating the Obion and the Forked Deer rivers as one item in appropriating for them, **99**, 2236, **1900**, 2890.

**Surveys.**

O. Leibrecth, of river below Dyersburg, Tenn., **73**, 57; **74**, 63, 375.

Survey from Dyersburg, Tenn., to junction with Obion River, thence to Mississippi River, with a view to making it navigable for that part, ordered by act of Aug. 17, 1894, made in that year under direction of Capt. J. Biddle (report unfavorable), **95**, 2265. Elevation of bench marks, **95**, 2274. Resurvey made in 1897, Dyersburg to Obion River, **97**, 2219.

Examination of the South Fork made, 1896, to ascertain what was necessary for maintenance, by Capt. Biddle, **97**, 2218.

## FORKED DEER RIVER, TENN.—Continued.

### Part C.—Forked Deer River, North Fork, Tenn.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 158; **81**, 213; **87**, 203.
ENGINEERS IN CHARGE:
Maj. W. H. Benyaurd, 1880. Report, **81**, 1492.
Capt. J. H. Willard. Report, **87**, 1484, 1494.
ASSISTANT. Z. Harrison. Report, **81**, 1493.

**Plans.**
By Maj. Benyaurd, 1880, South Fork to Obion, 24 miles, removing snags and other obstructions, and building wing-dams; estimate, $15,415.75, **81**, 1496.
In 1887 Capt. Willard, for removing obstructions; estimate, $20,000, **87**, 1484, 1494.

**Surveys.**
Ordered by act of June 14, 1880, made under direction of Maj. Benyaurd, **81**, 1492.
Examination below Dyersburgh, Tenn., ordered by act of Aug. 5, 1886, made under direction of Capt. Willard (report favorable), **87**, 1494.

**FORT BAYOU.** (See *Old Fort Bayou, Miss.*)

**FORT BENTON.** (See *Missouri River.*)

**FORT BROWN, TEX.** (See *Rio Grande.*)

**FORT COVINGTON, N. Y.** (See *Salmon River.*)

**FORT CREEK, IND.** (See *City West Harbor.*)

**FORT GEORGE, INLET.** (See *St. Johns River, Fla.*)

**FORT LEAVENWORTH, KANS.** (See *Missouri River between mouth and Sioux City.*)

**FORT MADISON, IOWA.** (See *Mississippi River from St. Paul to Des Moines Rapids.*)

**FORT MIFFLIN BAR.** (See *Delaware River.*)

**FORT POINT ROCK.** (See *San Francisco, Cal.*)

## FORT POND HARBOR, MONTAUK, N. Y.

**Commerce.**
Description of, **93**, 1078, 1080.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 70; **93**, 105.
ENGINEERS IN CHARGE:
Lt. Col. D. C. Houston, 1888. Report, **89**, 733.
Lt. Col. G. L. Gillespie, 1893. Report, **93**, 1077.

**Physical characteristics.**
Description of, **89**, 733; **93**, 1078, 1080.
The harbor is small and comparatively deep, situated on the north side of Long Island, 6 miles approximately from Montauk Point and 124 miles distant from Long Island City, **93**, 1078.

**Surveys.**
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Houston (report unfavorable), **89**, 733.
Examination ordered by act of July 13, 1892, made, 1892, by Lt. Col. Gillespie (report unfavorable), **93**, 1077.

## FORT ROSS, FISKS MILL, FISH ROCK, SHELTER COVE, TRINIDAD, ETC., CAL. (Harbor moorings at.)

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 353.
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1888. Report, **89**, 2498.

**Physical characteristics.**
Description of, **89**, 2498.

**Surveys.**
Examination ordered by act of Aug. 11, 1888, made 1888, under direction of Maj. Heuer (report unfavorable), **89**, 2498.

**FORT SMITH, ARK.** (See *Arkansas River.*)

**FOSTER CREEK, WASH.** (See *Columbia River.*)

**FOUR CHANNELS, LAKE CHAMPLAIN.** (See *Lake Champlain, N. Y. and Vt.*)

**FOURCHE LE FEVRE RIVER (FOURCHE LA FAIVE (FEVÉ)) RIVER, ARK.**

**Appropriations.**
1879, $10,000, **79**, 116, 971.
1880, 4,000, **80**, 1325.
1881, 3,000, **81**, 1514.
1882, 4,000, **82**, 1583.
1886, 5,000, **87**, 1532.
1890, 7,500, **90**, 1942.
Total, 33,500

**Commerce.**
Not unimportant, **72**, 387, 397; **79**, 972; unimportant, **93**, 2126.
Commercial interests to be subserved by improvement, **91**, 2045.
Description of, **95**, 2014.

**Engineers.**
Chief of Engineers. Reports, **71**, 59; **72**, 56; **78**, 89; **79**, 116, 118; **80**, 155; **81**, 218; **82**, 215; **83**, 223; **88**, 188; **89**, 221; **90**, 199; **91**, 251; **92**, 243; **93**, 274, 279; **94**, 252; **95**, 282; **96**, 245.
Engineers in Charge:
Lt. Col. W. F. Raynolds, 1872; **72**, 386.
Maj. W. H. H. Benyaurd, 1879–81. Reports, **79**, 971; **80**, 1323; **81**, 1435.
Capt. T. A. Handbury, 1881–83. Reports, **81**, 1514; **82**, 1583; **83**, 1171.
Capt. H. S. Taber, 1886–93. Reports, **87**, 1531; **88**, 1402; **89**, 1654; **90**, 1941; **91**, 2044; **92**, 1681; **93**, 2108, 2125.
Capt. C. F. Palfrey, 1894. Report, **94**, 1544.
Lt. Wm. L. Sibert, 1895. Reports, **95**, 2013.
Assistants:
A. H. Blaisdell. Report, **72**, 387.
Z. Harrison. Report, **79**, 972.
A. Walker, jr. Report, **93**, 2127.

**Operations.**
**1879–80.** Removal by hired labor of 7,557 trees and snags, and a number of rocks removed at shoals, **80**, 1324.
**1880–81.** 53 snags removed, rocks taken from shoals, and small dams built, **81**, 1435, 1514.
**1881–82.** 476 logs and snags removed, **82**, 1583.
**1882–83.** Removal of snags and trees, **83**, 1172. Operations discontinued to 1886, **87**, 1531.
**1886–87.** Partial formation of channel through Rock Shoal, **87**, 1531.
**1887–88.** Channel completed through shoal below Perryville, **88**, 1402.
**1890–91.** Snag boat built, **91**, 2044.
**1891–92.** 1,326 snags and stumps, 4 drift piles, and 923 c. y. rock and gravel removed from the channel, and 15,600 overhanging trees cleared from the banks, **92**, 1682.

**Physical characteristics.**
Description of, **72**, 387; **79**, 972; **93**, 2127. Floods, **72**, 387. Shoals, **79**, 973.

**Plans.** (See *Projects.*)
By A. H. Blaisdell, for improving river by removing snags and leaning trees, $25,890, **72**, 390.

**Projects.** (See *Plans.*)
By Maj. Benyaurd, 1879, removing snags, bowlders, and leaning trees, estimate, $23,034.50, **79**, 972; **81**, 1435.
After expending $26,000 on this project, Capt. Taber proposed to excavate a channel through certain rock shoals below Perryville; estimate, $7,650, **89**, 1655.
In 1892–93 plant was sold to appropriation for removing obstructions in Arkansas River, **93**, 2109.
Works of improvement effective, **95**, 2014.

**Surveys.**
Ordered by act of Mar. 3, 1871; assigned to Lt. Col. Raynolds, and made under his direction by A. H. Blaisdell. Report, **72**, 387.
Examination by Z. Harrison, under direction of Maj. Benyaurd. Report, **79**, 971.
Examination ordered by act of July 13, 1892, made 1893, under direction of Capt. Taber (report unfavorable) **93**, 2125.

**FOURMILE RUN, OHIO.** (See *Ohio River.*)

## FOX AND WISCONSIN RIVERS.[a] (See *Green Bay Harbor*; *Stockbridge Harbor; Transportation Routes to the Seaboard; Wolf River, Wis.*)

### Appropriations.[b]

| | |
|---|---|
| 1839, | $2,000.00 (survey), act Mar. 3.<br>[c] 500.00, act Mar. 3. |
| 1866, | [d] 2,000.00 (survey), **76**, ii, 195. |
| 1867, | 40,000.00 **68**, 301, 363; **76**, ii, 24.<br>[d] 15,000.00 (survey), **68**, 301, 363; **76**, ii, 24. |
| 1868, | [d] 22,000.00 (surveys), **76**, ii, 201. |
| 1870, | [e] 100,000.00, **70**, 57; **71**, 37. |
| 1872, | [f] 145,000.00, **72**, 35.<br>[g] 13,713.97, act June 10. |
| 1873, | 300,000.00, **73**, 36, 121, 220. |
| 1874, | 300,000.00, **74**, 42. |
| 1875, | 500,000.00, **75**, 45, 219. |
| 1876, | 270,000.00, **76**, 98, ii, 399. |
| 1878, | 250,000.00, **78**, 117, 1170.<br>[h] 5,310.00, **78**, 183. |
| 1879, | 150,000.00, **79**, 156. |
| 1880, | 125,000.00, **80**, 1952.<br>[h] 5,010.00, act June 16. |
| 1881, | 125,000.00, **81**, 2135. |
| 1882, | 200,000.00, **82**, 2167. |
| 1883, | [i] 2,460.00, act Mar. 3. |
| 1884, | 160,000.00, **84**, 1874. |
| 1886, | [i] 129,403.10, act Aug. 4.<br>56,250.00, **86**, 1689. |
| 1888, | [i] 100,024.53, act Feb. 1.<br>[i] 1,067.09, act Feb. 1.<br>[i] 10,539.25, act Feb. 1.<br>[j] 100,000.00, **88**, 1872.<br>[i] 15,318.26, act Oct. 19. |
| 1890, | 100,000.00,<br>[k] 156,552.70, **90**, 2369. |
| 1892, | 75,000.00,<br>[l] 109,022.33, **92**, 2217. |
| 1893, | [i] 30,985.50, act Mar. 3. |
| 1894, | 37,500.00, **95**, 2660.<br>6,263.34, act Aug. 23. |
| 1896, | [m] 3,000.00, **97**, 2713.<br>37,500.00, **96**, 2527. |
| 1899, | 27,500.00, **99**, 2790. |
| Total, | 3,728,920.07 |

### Commerce.

Object of the improvement, **78**, 1170.

Benefits to commerce by the improvement, **68**, 52, 353, 357, *et seq.*; **72**, 141; **73**, 222; **76**, ii, 230; **78**, 1171.

Benefits to local commerce, **79**, 1532.

List of boats navigating Fox River, 1866, H. Doc. 58, 39th Cong., 2d sess., 93.

Effect of railroads on the navigation and commerce, **68**, 358, 367.

Cost and receipts of Erie Canal, **73**, 223.

Convention at Oshkosh June 24, 1874; resolutions of, **74**, 162.

Navigation open on Fox River from Green Bay to Portage City, **78**, 117, 1169.

Tolls collected on Fox River:

| | |
|---|---|
| 1872–73 | $1,893.27, **73**, 222. |
| 1873–74 | 1,239.17, **74**, 162. |
| 1874–75 | 364.96, **75**, 217. |
| 1875–76 | 385.23, **76**, 98. |
| 1876–77 | 658.36, **77**, 880. |
| 1877–78 | 2,168.99, **78**, 1170. |
| 1878–79 | 2,993.58. **79**, 1533. |
| 1879–80 | 2,726.08, **80**, 1952. |
| 1880–81 | 2,336.99, **81**, 2135. |
| 1881–82 | 2,100.40, **82**, 2167. |
| 1882–83 | 625.00, **83**, 1714. |

Collection of tolls discontinued by act of 1882, **83**, 1714.

Effect of improvement upon freight rates, **88**, 1872.

The commercial use of the waterway least at Portage and most at the mouth of the river, **93**, 2759; **94**, 2105.

List of boats navigating the river, **93**, 2765; **94**, 2110; **95**, 2665; **96**, 2533; **97**, 2719; **98**, 2347.

The effect of the improvement of the river on freight rates by rail of greater importance than the traffic on the stream, **95**, 2660, 2665; **96**, 2527.

Much benefited by the construction of the harbor of refuge at Stockbridge, **98**, 2341.

### Contracts.

Impracticable on the Wisconsin River (Commissioner Richardson, 1853), **76**, ii, 217.

**1875.** C. C. Barker & Sons, locks, annulled for failure to prosecute with energy, **76**, ii, 413. Day & Call, locks and dams, abandoned, bankrupt, **76**, ii, 414. Conro, Starke & Co., dredging and repairs of Portage Canal, **76**, ii, 423, 424.

**1889.** S. A. Harrison, levee construction, $7,306, **90**, 2366.

**1899.** G. Ryan, towboat, $7,675, **1900**, 3714.

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[a] Surveys—Reports: Jan. 18, 1838; Feb. 6, 1838; Apr. 3, 1838; Jan. —, 1840, estimate, $447,470.18. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Statement of appropriations, **76**, ii, 398. Remarks by Maj. Houston on size of appropriations, **73**, 224; **74**, 162. Recommendation by Maj. Houston that appropriations be made for Fox and Wisconsin rivers, **73**, 223.

[c] Pier at north end of Lake Winnebago.

[d] Allotted.

[e] Wisconsin River.

[f] Purchase price of all rights of Green Bay & Mississippi Canal Co.

[g] Expenses of arbitrating: United States *v.* Green Bay & Mississippi Canal Co.

[h] Compensating commissioners for determining damages done to lands by the improvement of the rivers.

[i] H. Doc. No. 482, 55th Cong., 2d sess.

[j] Below Montello.

[k] Land damages and commissioner's salary.

[l] Flowage damages.

[m] Expense of Gen. Bragg investigating flowage.

## FOX AND WISCONSIN RIVERS—Continued.

**Defense.**

Naval station in Lake Winnebago, **76**, ii, 230.

**Documents.** (Not published in reports.)

H. Doc. 102, 25th Cong., 3d sess., Pettival's report, January, 1838. S. Doc. 318, 26th Cong., 1st sess., Capt. Cram's report, January, 1840. H. Doc. 55, 37th Cong., 3d sess., report on improvement company's work, **76**, ii, 223. H. Doc. 58, 39th Cong., 2d sess. H. Doc. 247, 40th Cong., 2d sess., Maj. Warren's report of progress. H. Doc. 185, 42d Cong., 2d sess., report of arbitrators. H. Doc. 176, 42d Cong., 2d sess., report of operations on Wisconsin River for 1871.

**Engineers.**

CHIEF OF ENGINEERS. Recommended legislation to secure title to lands for right of way, H. Doc. 74 and S. Doc. 6, 43d Cong., 2d sess.

Orders survey and project for first subdivision northern transportation route, **75**, ii, 521.

Transmits Maj. Houston's report on dams at Menasha, **76**, ii, 425.

Transmits Maj. Warren's final report, with remarks, **76**, ii, 189.

Reports, **66**, ii, 41, iii, 3; **67**, 35; **68**, 49, 51; **69**, 43; **70**, 57; **71**, 37; **72**, 35; **73**, 35; **74**, 42; **75**, 45; **76**, 92; **77**, 102; **78**, 117; **79**, 156; **80**, 209; **81**, 283; **82**, 278, 279, 2182, 2188, 2193; **83**, 287, 1725, 1731, 1736, 1737; **84**, 287, 1882, 1899; **85**, 310, 2045; **86**, 304; **87**, 270–272; **88**, 245, 247; **89**, 284, 286; **90**, 257, 258; **91**, 328, 329; **92**, 314, 315; **93**, 357, 359; **94**, 329; **95**, 366; **96**, 322; **97**, 406; **98**, 397; **99**, 471; **1900**, 536.

BOARDS OF ENGINEERS:

Convened at Cincinnati, Ohio, November 3, 1878, and at Baltimore, Md., February 19, 1879, to report on movable dams for the Upper Fox River. Report, **79**, 1547. (Majs. Craighill, Houston, and Merrill.)

Convened at New York, November 24, 1879, to report on plan for improvement of Wisconsin River. Report, **80**, 1953. (Cols. Tower and Newton and Majs. Abbot and Houston.)

Convened at Milwaukee, September 1, 1882, by S. O. No. 81, to report upon plan for restoration to natural width and capacity of Lower Fox River channel; also, for maintenance of Lake Winnebago and Little Buttes des Mortes, at their natural heights, by alterations in dams at Menasha and Appleton, **83**, 1725, 1727, 1738. (Lt. Col. Houston and Majs. Robert and Benyaurd.)

Convened at New York, January 5, 1884, to report upon proviso in river and harbor bill of March 1, 1883. Report, **84**, 1900, 1919. (Col. Newton and Lt. Cols. Abbot and Comstock.)

Convened by S. O. No. 98, at Milwaukee, September 17, 1884, to report on construction of works, purchase of lands, and present depth of water required in Upper and Lower Fox, **85**, 2041. (Lt. Cols. Poe, Merrill, and Barlow, and Capt. Marshall.)

Convened at New York December, 1886, to determine the practicability of contracting the Wisconsin River sufficiently to obtain a low-water navigable depth of 4 or 5 f. by low brush dikes and wingdams on the bed of the stream. Report, **87**, 2094. (Cols. Casey and Abbot, Lt. Cols. Comstock, Houston, and McFarland.)

ENGINEERS IN CHARGE:

Capt. T. J. Cram, original survey and plan, 1839, **75**, 218.

Col. C. Whittlesey, examination of Wisconsin River from Portage to sources, 1847, **76**, ii, 220.

Dr. B. F. Schumard, examination of Wisconsin River from Portage to mouth, 1849, **76**, ii, 220.

C. R. Alton, chief engineer to State board of public works, 1848–51. Report, **76**, ii, 213.

S. G. Callahan, examination of Wisconsin River, 1850, **76** ii, 217.

W. L. Dewitt, examination of Wisconsin River, 1851, **76**,ii, 216.

J. K. Anderson, chief engineer to State board of public works, 1851, **76**, ii, 214.

J. E. Day, consulting engineer to State board of public works, 1851, **76**, ii, 214.

D. D. Owen, U. S. Geologist, Geological Survey, 1852, **76**, ii, 219.

Commissioner Wm. Richardson, in charge, 1853. Report, **76**, ii, 217.

C. D. Westbrook, chief engineer, Fox & Wisconsin Improvement Co., 1854. Report, **76**, ii, 221.

D. C. Jenné, chief engineer Fox & Wisconsin Improvement Co., 1859. Report, **76** ii, 224,228.

N. M. Edwards, chief engineer Green Bay & Mississippi Canal Co., 1866, **76**, ii, 230.

Maj. G. K. Warren:

Survey and plans, 1866–70, **66**, 41.

Preliminary report, H. Doc. 58, 39th Cong., 2d sess., 41; **67**, 260.

Report on survey, **68**, 303, 350, 360, 363; **69**, 187; **70**, 226.

Retained maps at Newport, R. I., **71**, 120.

Final report referred to, **76**, 92.

## FOX AND WISCONSIN RIVERS—Continued.

Final report, **76**, ii, 189 et seq.

Col. J. N. Macomb, 1870–71. Report, **70**, 292.

Maj. D. C. Houston, work of improvement, May, 1871–84. Reports, **71**, 120; **72**, 132, 135; **73**, 218; H. Doc. 74, S. Doc. 6, 43d Cong., 2d sess.; **74**, 161; **75**, 216, 521; **76**, ii, 396; **77**, 877; **78**, ii, 1169; **79**, 1531; (Lt. Col.), **80**, 1947; **81**, 2131; **82**, 2165, 2183, 2190, 2194; **83**, 1712, 1726, 1732, 1737; **84**, 1872, 1887, 1925, 1939.

Capt. W. L. Marshall, 1884–89. Reports, **84**, 1872; **85**, 2025; **86**, 1686; **87**, 2077, 2097; **88**, 1869, 1878.

Maj. C. E. L. B. Davis, 1889–92. Reports, **89**, 2085, 2095; **90**, 2365, 2378; **91**, 2572, 2580.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2213, 2222; **93**, 2758, 2779; **94**, 2103.

Capt. C. F. Palfrey, 1895. Report, **95**, 2657.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2523; **97**, 2709; **98**, 2338.

Capt. J. G. Warren, 1899–. Reports, **99**, 2789; **1900**, 3712.

ASSISTANTS:

H. Meriton, dams, Wisconsin River, 1852, **76**, ii, 218.

Capt. C. R. Suter, surveys, 1866–68, **66**, 41; **68**, 305. Report, H. Doc. 58, 39th Cong., 2d sess., 73.

Capt. S. M. Mansfield, survey, **66**, ii, 41.

J. Z. Osborn, survey, H. Doc. 58, 39th Cong., 2d sess., 73; died in the field, **68**, 361; **69**, 199.

D. W. Wellman, general assistant and in charge of survey; office work, **69**, 199. Report and estimate, **68**, 351.

E. F. Ellsworth, survey, 1867, **76**, ii, 246.

W. W. Rich, survey, 1867, **68**, 305; **76**, ii, 246.

E. L. Billings, survey, 1867, **76**, ii, 246.

R. L. Dukes, survey, 1867, **69**, 199; **76**, ii, 246.

I. D. McKown, survey, 1867, **76**, ii, 246.

J. P. Cotton, survey, 1867, and report and estimates, **76**, ii, maps.

J. Blickensderfer, examination of Fox and Wisconsin rivers, 1869, **76**, ii, 198, 242.

H. C. Long, snag boats. Report, **69**, 203.

Capt. A. M. Miller, **72**, 135.

J. Nader, in charge Wisconsin River. Reports, **72**, 132, 141; **73**, 225, 243; **74**, 167.

J. Pierpont, assistant on Fox River. Reports, **72**, 148; **78**, 1177; **79**, 1538. Details of locks, **77**, 887.

N. E. Russell, survey on Fox River; in charge Upper Fox River, **73**, 226, 233; **74**, 164; **75**, 120. Survey on Fox River, **75**, 222.

W. J. Bryson, in charge upper section Fox River, **73**, 226; **74**, 164; **75**, 220.

L. Martin, in charge lower section Fox River, **73**, 226; **74**, 164; **75**, 220.

N. M. Edwards, in charge Fox River improvement, 1872–74, assistant to Capt. J. G. Lydecker. Reports, **73**, 233; **74**, 163.

Capt. J. G. Lydecker, May, 1874, to Apr., 1877, Fox River. Reports, **74**, 162; **75**, 219; **76**, ii, 412; **77**, 889.

Lieut. F. A. Hinman, July, 1874, to 1883, Wisconsin River. Reports, **74**, 166; **75**, 223; **76**, ii, 417, 422; **77**, 890; **78**, 1170; **79**, 1534. February, 1876, Upper Fox River. Reports, **76**, ii, 423; **77**, 888; **78**, 1174; **79**, 1536; (Capt.), **80**, 1961, 1967; **81**, 2135, 2140, 2141; **82**, 2174, 2167; **83**, 1714.

H. Liljencrantz, survey Fox River, **75**, 222; died, **77**, 887.

J. R. Berthelet, jr., overseer, Wisconsin River. Report, **76**, ii, 420.

E. C. Hinman, overseer, Wisconsin River. Reports, **76**, ii, 419; **79**, 1536, 1538.

C. A. Fuller, assistant engineer, Lower Fox River. Reports, **78**, 1179; **79**, 1544; **80**, 1969; **81**, 2144; **82**, 2178; **83**, 1721; **84**, 1874; **85**, 2033; **86**, 1695; **87**, 2081; **88**, 1872; **89**, 2088; **90**, 2369.

J. W. Allen. Reports, **83**, 1719; **84**, 1878, 1880; **85**, 2038, 2040.

N. M. Edwards. Report, **83**, 1735.

S. Whitney. Reports, **91**, 2572, 2581; **92**, 2217; **93**, 2760; **94**, 2106.

L. M. Mann. Reports, **95**, 2662; **96**, 2528; **97**, 2715; **98**, 2349; **99**, 2792; **1900**, 3716.

## FOX AND WISCONSIN RIVERS—Continued.

**Estimates.** (See *Plans* and *Projects.*)

| By— | Year. | For— | Wisconsin River. | Portage Canal. | Fox River. | Fox and Wisconsin rivers. | References. |
|---|---|---|---|---|---|---|---|
| Capt. Cram | 1840 | Improvement |  |  | $448,470 |  | **76**, ii, 210. |
| C. R. Alton | 1849 | .....do | $6,000 |  |  |  | **76**, ii, 213. |
| W. L. Dewitt | 1851 | Improvement in part. | 52,264 |  |  |  | **76**, ii, 216. |
| W. Richardson | 1853 | Improvement | 41,372 |  |  |  | **76**, ii, 217. |
| D. C. Jenné | 1862 | With boats 144 f. long, 6 f. draft. | 260,000 | $65,000 | 675,000 | $1,000,000 | **76**, ii, 229. |
| Do | 1862 | With boats 200 f. long, 6 f. draft. |  |  |  | 1,250,000 | **76**, ii, 229. |
| Col. Cram | 1863 | .....do | 315,000 | 70,000 | 2,002,384 | 2,387,384 | **76**, ii, 229. |
| Capt. Suter | 1866 | Survey | 15,000 |  |  |  | H. Ex. Doc. 58, 39th Cong., 2d sess., 41. |
| Maj. Warren | 1867 | Scraper and dredge boats. | 40,000 |  |  |  | **67**, 260. |
| Capt. Suter | 1868 | 4 f. draft | a 20,000 |  | 484,422 |  | Doc. 58, 42d Cong., **68**, 351; **73**, 219. |
| Do | 1868 | 6 f. draft | a 40,000 |  | 1,308,515 |  |  |
| D. W. Wellman | 1868 | To 3 f. by wing dams. | 427,747 |  |  |  | **68**, 354. |
| Do | 1868 | To 5 f. by dams and canal. | 3,206,790 |  |  |  |  |
| Do | 1868 | To 5-f. canal plan. | 4,164,270 |  |  |  |  |
| H. C. Long | 1868 | Snag boat and scraper. | 30,000 |  |  |  | **68**, 327. |
| Maj. Warren | 1868 | Experimental work. | 50,000 |  |  |  | **68**, 52. |
| Do | 1868 | Dams, etc., 3 f. draft. | 500,000 |  |  |  | **68**, 52, 360, 368. |
| Do | 1868 | Dams, etc., 4 f. draft. | 3,250,000 |  |  |  |  |
| Do | 1868 | Canal, 5 f. draft | 4,300,000 |  |  |  |  |
| Do | 1870<br>1875 | Canal, 4 f. draft | 4,000,000 |  |  |  | **70**, 226; **76**, ii, 293, 298. |
| Do | 1875 | Canal, 5 f. draft | 4,165,000 |  |  |  | **76**, ii, 298. |
| Maj. Houston | 1872 | Improvement of natural channel. | 426,044 |  |  |  | **72**, 140. |
| Do | 1873 | Various plans |  |  |  | 2,600,000 to 3,000,000 | **73**, 36, 224; **74**, 161. |
| Do | 1873 | Maximum est |  |  |  | 5,000,000 |  |
| Do | 1875 | .....do |  |  |  | 4,235,642 | **75**, 218. |
| Do | 1875 | .....do | 930,706 |  | 2,668,400 | 3,599,105 | **75**, ii, 523. |
| Do | 1875 | Final estimate |  |  |  | 3,745,663 | **76**, ii, 398; **78**, 1170. |
| Do | 1875 | Canal plan | 10,000,000 |  | 4,000,000 | 14,000,000 | **75**, 218, ii, 401. |
| Do | 1875 | Survey transportation route. |  |  |  | 10,000 | **75**, ii, 522. |
| Do | 1876 | Canal at Menasha |  |  | 106,558 |  | **76**, ii, 397, 411. |
| Do | 1876 | Enlarging Menasha Canal. |  |  | 40,000 |  | **76**, ii, 411. |
| Do | 1876 | Flowage damages |  |  | 1,000,000 |  | **76**, ii, 411. |
| Lt. Hinman | 1875 | Completion of improvement. | 400,743 |  |  |  | **75**, 225, 227. |

a Per annum.

Detailed estimates, by Capt. Suter, locks and dams on Fox River, **76**, ii, 231, 235, 240.

Detailed estimates, N. M. Edwards, Fox River works and canal at Portage, **73**, 242.

Estimate, by J. Nader, 6 f. draft on Fox River, $2,462,715, **73**, 229.

Estimates, Lt. Hinman, work required to complete improvement of Wisconsin River, **78**, 1172; to complete Fox River, upper section, **78**, 1176.

**Expenditures.**

1848–53, under State management, $428,855.83, **76**, ii, 219.

1853–59, under corporation management, $728,928.47, **76**, ii, 227.

Jan., 1860–Aug., 1862, $6,585.92, **76**, ii, 228.

1867, $28,000–$1,192,370.22, **76**, ii, 241.

For all surveys under Maj. Warren. $39,000, **76**, ii, 201.

Tables of expenditures by State and corporations, **76**, ii, 219, 227.

Details of expenditures, 1871, **73**, 243; 1871–72, **72**, 133, 134, 144, et seq.; **73**, 244.

Statement of monthly expenditures, 1872–73, on Fox River, **73**, 227; Wisconsin River, **73**, 230; 1873–74, on Fox

## FOX AND WISCONSIN RIVERS—Continued.

River, **74**, 165; on Wisconsin River, **74**, 168, 172.

**Financial Statements.** (See also *Expenditures.*)

Bonds of Fox and Wisconsin Improvement Co., 1853, $500,000, **76**, ii, 221.

**Legal Proceedings.**

Condemnation proceedings, session of jurisdiction, and land purchases, **93**, 2759, 2763; **94**, 2109; **95**, 2665, 2669; **97**, 2716; **99**, 2789; **1900**, 3713.

Regulations of Secretary of War for navigation and use of locks and canals of Fox River, **95**, 2661.

Efforts to control the use of the waters of the waterway for power by mills along the banks, **93**, 2763; **94**, 2106; **95**, 2658, 2665; **96**, 2525, 2532; **97**, 2714. Rule established for the restraint of such use a hardship to many mills, **95**, 2659; rule rescinded, temporarily, **96**, 2525.

Prosecution of violaters of the rule of the Secretary of War for the restriction of the use of the waters of the waterway for power, etc., **96**, 2526; **97**, 2714; **98**, 2341, 2348; **99**, 2792; **1900**, 3716.

Citizens of Stockbridge, Lake Winnebago, set aside and donated land for a harbor of refuge there and a highway to it in 1896, **97**, 2712.

Discussion of investigations made to determine the rights of individuals and those of the United States in connection with the improvement of Fox River and Wisconsin River, **98**, 2341.

**Legislation.** (See *Legal Proceedings*).

Recommendations of Senate Committee on Roads and Canals, Feb. 11, 1839, that the United States make a grant of land for the improvement, **76**, ii, 208. Acts of Congress, Aug. 8, 1846, Aug. 3, 1854, Mar. 3, 1855, Mar. 12, 1867, granted five sections of land per mile of the Fox River and canal and lakes (216 miles) to the State of Wisconsin to aid in the improvement, **76**, ii, 223; **79**, 1531. Act in full, **76**, ii, 221. Act of Congress, July 23, 1866, required a survey to be made under direction of the Secretary of War, **76**, ii, 230. Act of Congress, July 11, 1870, prohibiting expenditures until the Green Bay and Mississippi Canal Co. agree to convey its property and franchises, **70**, 57, 292; **72**, 35. Act in full, **73**, 224. Act of Mar. 3, 1875, relating to flowage damages, **76**, ii, 397.

*Acts of Wisconsin legislature*, June 29, 1848, accepting grant, **76**, ii, 211. Aug. 8, 1848, providing for the improvement, **76**, ii, 211. July 6, 1853, chartering Fox and Wisconsin Improvement Co., **76**, ii, 220. 1856. Requiring 3½ and 4 f. navigation on Fox River, **76**, 223. 1866. Organizing Green Bay and Mississippi Canal Co., **76**, ii, 230.

*Legislation required* to prevent conflict with owners of water franchises on Fox River, **73**, 222; to obtain title to lands for right of way, H. Ex. Doc. 74, S. Doc. 6, 43d Cong., 2d Sess. Flowage claims, and lowering the dams at outlet of Lake Winnebago, report of Maj. Houston on, **76**, ii, 109. Letter to Secretary of War from the Chief of Engineers on same, **76**, ii, 424. Maj. Houston recommends removal of claims for damages out of State courts and reference to United States commissioners, **78**, 1170. (See also H. Doc. 74 and S. Doc. 6, 43 Cong., 2d sess.) Excessive damages awarded by State courts, H. Doc. 51, 45th Cong., 3d sess.

Chief of Engineers recommends inquiry into damages caused by Fox and Wisconsin improvement, **81**, 2149.

Wisconsin State law governing ascertainment and payment of damages caused by Government works, **81**, 2148. Act of Wisconsin Territory, 1848, authorizing construction of Menasha Dam, **82**, 2185; claims against United States in 1875 for damages caused by Menasha Dam, **82**, 2187. Report on same by Maj. Houston, **82**, 2190.

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Proviso of 1882, **83**, 1727.

Statement of leading points in suit of Syme *vs.* Fuller, **84**, 1887; judgment for Syme delivered by Supreme Court, **84**, 1896.

List of awards made in 1876 for flowage damages, **84**, 1891.

Congress in 1894 empowered the Secretary of War to control the use of the waters of this waterway, **95**, 2661; and in 1896 empowered the Secretary of War to make use of flush boards or otherwise to make avail of all the natural flow of water and prevent waste, **98**, 2344.

**Operations.**[a]

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**1866–67.** Surveys by Capt. Suter and Maj. Warren. (See *Surveys.*)

**1867–68.** Survey continued. Steamer *Caffrey* attempted to enter river, **69**, 203.

**1868–69.** Snag boat *Winneconne* purchased ($8,500, **69**, 43; $8,000, **70**, 226; **76**, ii, 242) and set to work, **69**, 43, 190; **70**, 57.

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[a] History of operations, 87, 2094. Statement of total expenditures on Fox and Wisconsin rivers, 87, 2106.

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**1869–70.** *Winneconne* removed snags from Portage to Sauk City, 30 miles. Drew too much water, **70**, 226. Examination by Maj. Warren, **76**, ii, 242.

**1870–71.** Work suspended, **70**, 292. (See *Legislation.*)

**1871–72.** Experimental work on proposed canal crossings commenced July 1, by dikes and dams of brush and stone, **71**, 120. Report on same, **72**, 135, 143. Result favorable to improvement of natural channel, **72**, 132. Plans of wing-dams, **72**, 144.

**1872–73.** Same work continued from July 1 with satisfactory results, **73**, 218; report on, by Maj. Huston, **73**, 229; by J. Nader, **73**, 244; **74**, 170. 39 miles of river improved, **74**, 167, 173.

**1873–74.** Wing dams; detailed report on, **74**, 169. Details of work and materials for, **74**, 171.

**1874–75.** 118 dams=48,847 l. f. built to date, **75**, 224. Unfavorable opinions expressed as to permanence of channel, **75**, 217. Tables of completed dams built, **75**, 224, 227. Grand excursion and resolutions, **75**, 226.

**1875–76.** Operations as before, **76**, ii, 399. Detailed reports on method of improvement, **76**, ii, 402, 417, 422. Reasons for delay in completion, **76**, ii, 418. Table of completed dams built and work done, **76**, ii, 418.

**1876–77.** Results demonstrate the practicability of the improvement, **77**, 880, 890.

**1877–78.** Examination showed that channel formed by work of improvement had been maintained, **78**, 1170, 1171. Soundings taken about once a year since 1875 on upper improved section, **78**, 1171.

**1878–79.** Repairs and extension of dams, snagging, bank protection, etc., **79**, 1536. Operations suspended pending action of Board of Engineers, **79**, 1533.

**1879–80.** Repairs and extensions to dams between Portage City and Wild Cat Bluffs; five dams with a total length of 4,625 f. built above Prairie du Sac; 530 f. of dam extension on upper section; brush and stone collected, **80**, 1951.

**1880–81.** 41 wing dams with a total length of 19,308 f. constructed between Portage and Rocky Run, **81**, 2133.

**1881–82.** 7,441 l. f. wing dam constructed, **82**, 2166.

**1882–83.** 9,320 l. f. wing dam constructed, **83**, 1713.

**1884–85.** Repairs to dams, **85**, 2025; **86**, 1686; **87**, 2077.

**1885–86.** Further efforts to improve river by wing dams discontinued, **87**, 2077, 2096.

FOX RIVER:

**1872–73.** Works transferred to United States from Green Bay and Mississippi Canal Co., Oct. 1, 1872, **73**, 225. Repairs on Lower Fox and to levee at Montello; dredging; quarries opened, **73**, 226.

**1873–74.** Dredging on levels, repairs to old locks and dams on Lower Fox, new lock and stone dam, surveys on Upper Fox, **74**, 42. Detailed report, **74**, 162.

**1874–75.** Lock and dams; repairs, surveys, detailed reports, **75**, 220.

**1875–76.** Portage Canal enlargement completed; 2 new locks and 5 new dams; dredging; locks let by contract; contractors failed. Reports, **76**, ii, 396, 412, 423. Statement of work on canal at Portage, **76**, ii, 423.

**1876–77.** New locks, dams; dredging; line opened so far as locks are concerned June 1, 1876. Reports, **77**, 877, 880, 888.

**1877–78.** New dams, repairing locks, quarrying stone, dredging, etc., **78**, 1169, 1174. Navigation open from Portage City to Green Bay, **78**, 1169.

**1878–79.** Dredging, repairs of locks, widening Portage Canal, commencement of new lock, and crib dam, retaining wall, etc., **79**, 1538–1547.

**1879–80.** *Lower Fox:* Construction of new lock at Little Chute; construction of revetment wall of Appleton Canal, and wasteweir in third level of same; canal banks strengthened and break of Menasha repaired.

*Upper Fox:* 460,931 c. y. dredged; repairs to Portage guard lock and dams at Eureka, Berlin, White River, and Princeton; snags removed, **80**, 1950.

**1880–81.** *Lower Fox:* Completion of new lock at Little Chute; construction of masonry wall across head of old guard lock; elevation of canal banks; completion of revetment wall of Appleton Canal; construction of wasteweir in Little Chute Dam; general repairs to locks and dams.

*Upper Fox:* 519,473 c. y. dredged; construction of lock-tender's house at White River; minor repairs to dams, locks, and canal banks, **81**, 2133.

**1881–82.** *Lower Fox:* Construction of stone-masonry lock at Kaukauna.

*Upper Fox:* 335,681 c. y. dredged; 800 l. f. of river bank protected from washing, by piles, brush, and stone, **82**, 2165, 2166.

**1882–83.** *Lower Fox:* Construction of retaining wall for canal bank above Kaukauna; construction of first new lock at Appleton, and alteration of dams at Menasha and Appleton commenced.

*Upper Fox:* 124,208 c. y. dredged; repairs to locks, dams, and canal banks, **83**, 1713.

**1883–84.** *Lower Fox:* Appleton first lock completed; sluiceways and gates built in Appleton Upper Dam; water on bars and in canals deepened by dredging;

## FOX AND WISCONSIN RIVERS—Continued.

repairs to lock gates, canal embankments, and dams.

*Upper Fox:* Repairs to lock gates at Fort Winnebago, Governors Bend, Princeton, Berlin, and Eureka, **84**, 1872.

**1884-85.** *Upper Fox:* 74,371 c. y. dredged; boats and dredges repaired, **85**, 2025.

*Lower Fox:* Repairs to old lock at Menasha and to Appleton fourth and Little Chute first locks; new abutment built and apron begun at Little Kaukauna Dam; repairs to locks and dams and dredging in canals, **85**, 2026.

**1885-86.** *Upper Fox:* Old locks at Governors Bend and Montello repaired; 97,596 c. y. dredged from bars in Upper Fox; repairs to Eureka Dam.

*Lower Fox:* Right abutment and 178 l. f. of new dam at Menasha built; 1,506 cords stone blasted and removed from Menasha Channel; 20,449 c. y. clay dredged from outlet of Lake Winnebago; apron completed and sluice built in Little Kaukauna Dam; repairs to locks and dams, **86**, 1687.

**1886-87.** *Upper Fox:* Repairs to locks and dams and maintenance of existing depth of navigation by dredging; levee built at White River Lock, **87**, 2077, 2082, 2087.

*Lower Fox:* New lock built at the Cedars; De Pere Lock renovated; Menasha Dam and sluice completed; Menasha Channel deepened by rock removal; De Pere Dam completed; new stone abutment built at Rapide Croche Dam, and the injury from high water of 1881 repaired, **87**, 2078, 2082, 2084, 2087.

**1887-88.** 161,747 c. y. dredged from bars on the Upper Fox; 63,148 c. y. gravel and sand dredged from channel on the Lower Fox; repair and construction of locks and dams; repair of boats and dredges, **88**, 1870, 1877.

**1888-89.** 140,882 c. y. dredged from bars on the Upper Fox; 10,883 c. y. material dredged from Menasha River; extensive repairs to dredging plant and tugboats; construction of Appleton Lower Dam continued; extensive repairs to Rapide Croche and Menasha locks, **89**, 2085.

**1889-90.** Levee at Portage built under contract; new lower dam at Appleton completed; 25,000 c. y. dredged; operation, care, and repair of locks, dams, and canals, **90**, 2366-2376.

**1890-91.** Construction of guard gates beyond at head of Kaukauna Canal; head wall and feeder built at head of old first lock at Appleton; brush and stone wing dam built at Portage Levee, **91**, 2573; 38,214 c. y. dredged in Lower Fox, Neenah Channel, and mouth of Fond du Lac River, **91**, 2578. Construction and repair of plant; operation and care of locks and dams, **91**, 2580, 2587.

**1891-92.** Guard gates at head of Kaukauna Canal completed; 3,117 c. y. of rock blasted and removed, and 1,110 c. y. dredged from rock bar at river outlet of De Pere Lock; 80,145 c. y. dredged at points on the Lower Fox; 13,577 c. y. dredged on Fox River, between De Pere and Green Bay; buoy construction and repairs to plant, **92**, 2217, 2219; operation and care of locks and dams, **92**, 2222.

FOX—WISCONSIN:

**1892-93.** Lock to replace an old one built at Portage, Wis.; construction of channel at Grignon Rapids in progress; new middle platform built in the combined locks at Little Chute; a part of the Kaukauna Canal bank rebuilt and a part of the bed puddled with clay; two new lock houses were built, and dredging plant repaired, **93**, 2759.

**1893-94.** Lock at Portage finished; dredging in Grignon Rapids and in the river between Rapide Croche Dam and Wrightstown Bridge completed; waste weir and culvert constructed at combined lock; wing walls at Kaukauna fourth lock rebuilt; 587 l. f. core wall constructed in the canal banks of the fourth and fifth levels at Kaukauna; and locks, dams, houses, and dredging plant repaired, **94**, 2105.

**1894-95.** Crib dam at Berlin lock completed; fourth lock at Appleton rebuilt; waste weirs for Kaukauna system completed; construction of dam and straight cut at White River lock begun; works, buildings, and plant repaired, **95**, 2659.

**1895-96.** Crib dam at White River lock completed; lock house and warehouse at Appleton lock completed; harbor at Fond du Lac dredged, and bar dredged at intersection of Fox River with Lake Butte des Morts, **96**, 2526.

**1896-97.** Waste weir constructed at Kaukauna second lock; roadway built at Appleton first lock; fishways constructed in the Eureka, Berlin, and White River dams, and a small amount of dredging done, **97**, 2712.

**1897-98.** Crib dam and fishway built at Princeton, and old dam removed; old dam at Grand River removed, and construction of permanent crib dam begun; harbor of refuge dredged at Stockbridge Landing, Lake Winnebago; bars in Wolf River dredged, and snags and other obstructions removed from that river; scow built, and dredging plant repaired; channels dredged below Kaukauna fifth and Rapide Croche locks, and canal above Rapide Croche and Appleton second locks;

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boring of several wells in progress, **98**, 2341.

**1898-99.** Permanent crib dam with masonry abutments at Grand River completed, and old dam removed; fishways built in 3 dams; channel dredged below Menasha lock; and miscellaneous work, **99**, 2789.

**1899-1900.** Channels on the Upper Fox dredged; some dredging below Menasha lock and above Appleton fourth lock; revetment built, piers repaired at harbor of refuge; some dredging and some snag removal on Wolf River; miscellaneous work. (About 275,000 c. y. dredged.) **1900**, 3712.

**Physical characteristics.**

Fox River:

Upper Fox described, **76**, ii, 235.

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One level of the Fox River improvement, that above Menasha, maintained by 2 dams, 1 of them belonging to the U. S., **98**, 2346.

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By Commissioner Crosswell, for Wisconsin River, **76**, ii, 215.

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**1848.** State board of public works; surveys and plans, **76**, ii, 212.

**1849.** State board of public works; commenced operations on Fox River and made examination of the Wisconsin, **76**, ii, 213.

**1850.** State board of public works; operations on Fox and Wisconsin Rivers, **76**, ii, 213.

**1851.** State board of public works; operations on Fox and Wisconsin Rivers and on Portage Canal, **76**, ii, 214.

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**1853.** Fox & Wisconsin Improvement Co. chartered, **76**, ii, 220. History of, **76**, ii, 220.

**1854.** Report of Chief Engineer C. D. Westbrook on operations by Fox & Wisconsin Improvement Co., **76**, ii, 221.

**1855–59.** Fox & Wisconsin Improvement Co.'s operations on Fox River. Report of Chief of Engineers, **76**, ii, 224.

**1860–62.** Fox & Wisconsin Improvement Co.'s operations on Fox River. Report of Chief of Engineers, **76**, ii, 225, 228.

**1866.** Fox & Wisconsin Improvement Co. sold out by trustees. Green Bay and Mississippi Canal Co. organized, **76**, ii, 230.

**1867–69.** Operations by Green Bay & Mississippi Canal Co., **76**, ii, 241, 242.

**1872.** Works transferred to the United States, as per report of board of arbitrators (H. Doc. 185, 42d Cong., 2d sess.), which awarded $325,000 to the company for the property, rights, and franchise, $180,000 being deducted by the Secretary of War for property not needed by the United States; $145,000 was appropriated (June 10, 1872) and paid, **72**, 35; **73**, 219. The company retained the water-power franchise, a source of conflict, **73**, 222; **74**, 163, 166. List of works transferred, **79**, 1532.

Results of corporate work summed up, H. Doc. 58, 39th Cong., 2d sess., p. 74.

Fox River Improvement Co.'s works examined by Maj. Houston, **73**, 219.

Railroad bridges modified, **75**, 224, 226; **76**, ii, 433, 434; **77**, 888.

History of early explorations, **76**, ii, 203; of early State and corporate work, **76**, ii, 212, 220.

Neenah & Menasha Waterpower Co. granted permission, 1899, to place 8-inch flushboards on the Menasha dam, **99**, 2790, **1900**, 3713.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Houston, operations on Wisconsin River, **72**, 135. The project adopted, at total cost of $3,745,663, **75**, 218; **76**, ii, 398; **78**, 1170.

The permanent works for the improvement of the Fox and Wisconsin rivers were purchased by the United States in 1872 from the Green Bay & Mississippi Canal Co. for $325,000, **72**, 35; **73**, 219. The subsequent project proposed slackwater navigation of the Fox River by replacing the temporary structures with permanent works and the construction of 5 additional locks on the Upper Fox, the improvement of the Wisconsin River by wing dams and dikes, so as to obtain throughout a depth of 6 f. for a width of 100 f.; estimate, $3,745,663, **75**, 218; **78**, 1170; **80**, 1952; **87**, 270.

By Board of Engineers, 1884, for reconstruction of dam at Menasha, below site of present dam, across full width of Menasha Channel, and enlargement of Neenah Channel by dredging; also, for purchase of lands and structures, **85**, 2044; **86**, 1689.

The Board of Engineers of 1886 decided against further attempts to improve the low-water navigation of the Wisconsin River by wing dams, **87**, 2096.

By Capt. Zinn, 1896–97, for dredging a harbor of refuge in Lake Winnebago at Stockbridge, **97**, 2712.

By Capt. Zinn, 1896, for the removal of snags and other obstructions from Wolf River between New London and Lake Poygan, a distance of 47 miles, and for dredging an 80-f. wide channel 4½ f. deep at medium stage through five bars amounting in length to 2,000 f., and also for the removal of a wrecked steamer; using for the purposes mentioned the approppriation of $1,500 made in the act of 1896, **97**, 2716.

In 1897 Capt. Zinn estimated it would cost $180,866.48 to complete the improvement of Fox River, **97**, 2714; in 1898, $163,967.52; acquiring control of dam above Menasha recommended, **98**, 2346.

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**Secretary of War.**

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Recommends legislation as to title to lands for right of way, H. Doc. 74, 43d Cong., 2d sess., and S. Doc. 6, 43d Cong., 2d sess.

**Surveys.**

**1836.** By Mr. Centre, C. E., under directions of Col. Abert, U. S. T. E., entrance to Fox River. Report dated Apr., 1838. **76**, ii, 208.

**1837.** By Mr. Pettival, C. E., under Topographical Engineer Bureau, of Fox River. Report printed as H. Doc. 102, 25th Cong., 3d sess. **76**, ii, 208.

**1839.** By Capt Cram, U. S. T. E., of Fox River. Report, S. Doc. 318, 26th Cong., 1st sess., **75**, 218; **76**, ii, 209.

**1847.** By Col. C. Whittlesey, examination of Wisconsin River from source to Portage. Report in Geological report, Lippincott, Grambo & Co., Philadelphia, 1852. **76**, ii, 220.

**1849.** By Dr. B. F. Schumard, examination of Wisconsin River from Portage to mouth. Report in Geological report, Lippincott, Philadelphia, 1852. **76**, ii, 220.

**1852.** Geological survey of the Wisconsin by D. D. Owen, U. S. G. Report, Lippincott, Philadelphia, 1852. **76**, ii, 219.

**1866.** Preliminary examination and survey by Capt. Suter, under direction of Maj. Warren. Report, H. Doc. 58, 39th Cong., 2d sess., p. 74. **66**, iii, 35; **67**, 35. No reliable survey ever made of the Wisconsin River, same document, p. 95. Detailed estimate for such a survey, same document, p. 103.

**1867.** Survey of Wisconsin River, under direction of Maj. Warren, by Capt. Suter, commenced Aug. 26, **68**, 49. Fully described by Maj. Warren, **76**, ii, 243. Instructions of Maj. Warren for survey, **68**, 303; **76**, ii, 244. Office work by D. W. Wellman. Result of work on survey, **68**, 363; **76**, ii, 247. Estimate for additional survey, $7,500, **68**, 362. Final report by Maj. Warren, **76**, ii, 190. Cost of all surveys under Maj. Warren for this improvement, $39,000, **76**, ii, 201.

**1874.** Survey under direction of Maj. Houston for northern transportation route to the seaboard, **74**, 161; **75**, ii, 521. Survey of channel of Fox River, **74**, 166. Surveys of Upper Fox River completed, **75**, 216; described, **75**, 222; platted, **76**, ii, 398.

**1875–78.** Soundings taken about once a year on upper improved section of Wisconsin River, **78**, 1171. Soundings of 1878, **78**, 1172.

Examination of Wisconsin River, Portage to Merrill, made, 1882, under direction of Lt. Col. Houston, **84**, 1939.

Survey of Fox River, De Pere to Green Bay, made, 1888, under direction of Maj. Davis, **89**, 2086.

Minor surveys and examinations, **93**, 2763; **95**, 2659; **96**, 2526; **97**, 2712, 2716.

Examination as to the necessity and advisability of building a protection wall at Kaukauna, ordered by act of July 13, 1892, made in 1892 by Maj. Gregory, (report unfavorable), **93**, 2779.

Harbor at mouth of Fond du Lac surveyed in 1894–95, **95**, 2664.

Survey for a harbor of refuge on the east shore of Lake Winnebago, ordered by act of June 3, 1896, made under the direction of Capt. Zinn in 1896 (see *Projects*), **97**, 2716.

Examination of Wolf River with a view to removal of bars and snags below Shawano, ordered by act of June 3, 1896, made in 1896 under direction of Capt. Zinn (see *Projects*), **97**, 2716.

Congress in 1896 directed that a thorough investigation of the character, limitations, and description of the property and rights of the United States in connection with the improvement of Fox and Wisconsin rivers be made under the direction of the Secretary of War, made by Gen. E. S. Bragg, report, **98**, 2353.

Surveys of land required along the river for which clear title should be obtained in progress, 1900, **1900**, 3713.

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Mouth of Wisconsin River, Warren's report, pl. 2, **76**, ii, 296.

Wisconsin River in sections, Warren's report, pls. 3–8, **76**, ii, 296.

Portage Canal and parts of Wisconsin and Fox rivers, Warren's report, pl. 9, **76**, ii, 296.

Profiles of stages, Lake Winnebago, etc., Warren's report, pl. 10, **76**, ii, 296.

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Former extent of Lake Winnebago, (Warren), **76**, ii, 271.

Wisconsin River canalized (Warren), **76**, ii, 282.

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Method of improving Wisconsin River, **76**, ii, 408.

Dam and lock details on Fox River, **76**, ii, 416.

View of mouth of Wisconsin River (Warren's report, map cover), **76**, ii, 296.

Land-office maps very unreliable, H. Doc. 58, 39th Cong., 2d sess., p. 73.

Scale of maps and progress on, **68**, 363; **69**, 191; **76**, ii, 398.

Survey, Wisconsin River, described (Warren), **76**, ii, 247.

**90**, 2366; **98**, 2348.

## FOX RIVER, WIS., LOCKS AND DAMS (Operating and care).

(See *Fox River, Wis.*)

**Appropriations.**[a]

| | |
|---|---|
| 1885, | $46,687.40 |
| 1886, | 42,622.00 |
| 1887, | 42,061.65 |
| 1888, | 52,204.77 |
| 1889, | 48,329.62 |
| 1890, | 76,874.27 |
| 1891, | 68,989.00 |
| 1892, | 55,989.98 |
| 1893, | 33,551.90 |
| 1894, | 36,958.24 |
| 1895, | 40,438.60 |
| 1896, | 50,225.16 |
| 1897, | 66,317.49 |
| 1898, | 62,597.03 |
| 1899, | 66,959.21 |
| 1900, | 73,064.65 |
| Total, | 863,870.97 |

**Commerce.**

The commerce of the lower Fox increased by the maintenance of the waters of the waterway at the height of the crests of the various dams, **98**, 2397.

**Contracts.**

Details of expenses given in each annual report.

**1899.** G. Ryan, hull and cabin for towboat, $5,635, **1900**, 3723.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 358; **94**, 330; **95**, 367; **96**, 323; **97**, 407; **98**, 399; **99**, 473; **1900**, 537.

ENGINEERS IN CHARGE:

Maj. J. F. Gregory, 1892–94. Reports, **93**, 2766; **94**, 2111.

Capt. C. F. Palfrey, 1895. Report, **95**, 2666.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2534; **97**, 2719; **98**, 2395.

Capt. J. G. Warren, 1899–. Reports, **99**, 2794; **1900**, 3721.

ASSISTANTS:

S. Whitney. Reports, **93**, 2767; **94**, 2111.

L. M. Mann. Reports, **95**, 2666; **96**, 2535; **97**, 2720; **98**, 2396; **99**, 2795; **1900**, 3724.

**Legal proceedings.**

Illegal use of water by manufactories on the lower Fox, **96**, 2535.

Enforcement of the rules and regulations of the Secretary of War for navigation and use of locks and canals the means of bringing about more satisfactory conditions for all concerned, **98**, 2396.

**Obstructions.**

The use of the waters of the waterway by manufactories along the banks a cause of low water, **96**, 2535.

**Operations.**

**1892.** Channels of river and canals of the system dredged, lock-houses, locks, dams, canal banks, and dredging plant repaired. (See each annual report.)

See tables of dredging from 1894 in each annual report.

**Physical characteristics.**

Discharge observations, **96**, 2537; **97**, 2721, 2722, 2750; **98**, 2397.

Hydrograph of Oshkosh water gauge, **98**, 2396.

In 1896–97 the water of the waterway was maintained for the first time at the level of the dam crests, and such maintenance was due to the enforcement of the rules and regulations of the Secretary of War for the regulation of the navigation of the waterway, **97**, 2720.

Horsepowers of each of the Government and private dams of the waterway, **97**, 2722, 2723.

Statistics of water power of the lower Fox River, **97**, 2732.

Hydrographs, **99**, 2804; **1900**, 3724.

**Surveys.**

Minor, **96**, 2549; **97**, 2730; **98**, 2401; **99**, 2803; **1900**, 3722.

MAPS. Index, **97**, 2751.

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[a] Expenditures under permanent indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## FRANKFORD CREEK, PA.

**Appropriations.**
1882, $10,000, **83**, 612.
1894, 2,000, **95**, 1076.

Total, 12,000

**Commerce.**
Statement of manufacturing industries concerned. Value and capacity of the Frankford Arsenal. **82**, 826, 827.

**Contracts.**
**1883.** American Dredging Co., dredging, 23 cents per c. y., **83**, 612.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **81**, 129; **82**, 127; **83**, 117; **84**, 127; **85**, 119; **86**, 116; **87**, 78; **88**, 77; **95**, 131; **96**, 121.

ENGINEERS IN CHARGE:
Capt. W. Ludlow, 1881–83. Report, **82**, 822.
Lt. Col. G. Weitzel, 1883–84. Report, **83**, 611.
Maj. W. H. Heuer, 1884–85. Report, **84**, 810.
Lt. Col. H. M. Robert, 1885–88. Reports, **85**, 836; **86**, 829; **87**, 799; **88**, 698.
Maj. C. W. Raymond, 1890–96. Reports, **95**, 1075; **96**, 935.

ASSISTANTS:
E. A. Giesler. Report, **82**, 824.
A. Stierle. Reports, **83**, 612; **84**, 811.
E. D. Thompson. Report, **96**, 937.

**Operations.**
**1882–83.** 35,178 c. y. dredged from the channel, **83**, 612.

**Physical characteristics.**
Description of creek and its obstructions, **82**, 823.

**Plans.**
Col. Robert reported, 1888, commercial interests of the creek did not warrant further appropriations, **88**, 698, 699.

**Private (corporate) work.**
The Pennsylvania R. R. Co. straightened the channel of the creek at its own expense between Tulip and Roxborough streets in 1896, **96**, 936.

**Projects.**
By Capt. W. Ludlow, 1882, channel, mouth of the creek to Frankford Avenue Bridge, having a low-water depth of 7 f. at the mouth, decreasing to 3 f. at the bridge, with a bottom width of 50 f.; estimate $40,000, **82**, 823. No further operations recommended, **84**, 811; **87**, 799.

Congress, 1894, made an appropriation for the straightening of the creek between Tulip and Roxborough streets, Philadelphia, **95**, 1075. The Pennsylvania R. R. was given permission to do the work by the Secretary of War under certain conditions, **96**, 937.

**Surveys.**
Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. W. Ludlow, **82**, 822.
Survey made under the direction of Maj. Raymond, 1896, **96**, 936.
MAPS. **95**, 1076.

## FRANKFORT (AUX BECS SCIES) HARBOR, MICH.[a] (See *Grand Haven Harbor, Mich.*)

**Appropriations.**[b]
1866, $88,541.00, **66**, iii, 10, 35, iv, 91.
1867, 10,000.00, **67**, 26.
1868, 10,000.00 (allotted), **68**, 36.
1869, 29,318.85 (allotted), **69**, 22.
1870, 8,115.00, **70**, 40, 129.
1871, 10,000.00, **71**, 38.
1872, 10,000.00, **72**, 36.
1873, 10,000.00, **73**, 37.
1874, 10,000.00, **74**, 42.
1875, 10,000.00, **75**, 47.
1876, 3,000.00, **76**, 100.
1878, 8,800.00, **78**, 120.
1879, 4,000,00, **79**, 162.
1880, 5,000.00, **80**, 2010.
1881, 10,000.00, **81**, 2201.
1882, 15,000.00, **82**, 2284.
1884, 5,000.00, **84**, 1974.
1886, 7,000.00, **86**, 1758.
1888, 8,000.00, **88**, 1902.

**Appropriations**—Continued.
1890, 10,000.00, **90**, 2612.
1892, 10,000.00, **92**, 2320.
1894, 50,000.00, **95**, 2814.
1896, 15,000.00, **96**, 2714.
1899, 35,000.00, **99**, 2945.

Total, 381,774.85

**Commerce.**
Benefit of improvement, **66**, iv, 95; **68**; 135; **71**, 185.
Importance as harbor of refuge, **68**, 135; **71**, 177, 185; **76**, 100; **77**, 903.

**Contracts.**
**1866.** Macdonnel & Co.,[c] materials and labor, **66**, iv, 94.
**1866–69.** Whitwood & Hubbell, materials and labor, **66**, iv, 94, 95; **67**, 59, 119; **69**, 86.

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[a] Survey.—Report, Oct. 14, 1864; estimate $88,541.) H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Allotment of 1869 called $31,500, **69**, 30. Transferred from appropriation for this harbor to Grand Haven, Mich., $1,885, **70**, 40, 129. Statements of appropriations, **74**, 175; **76**, ii, 465; **79**, 1602.

[c] Failed to furnish bonds, **66**, iv, 94.

## FRANKFORT (AUX BECS SCIES) HARBOR, MICH.—Continued.

**1871.** C. S. Stevens,[a] materials and labor, **71**, 132. T. S. White, dredging, **71**, 132. W. Nichols, labor, **71**, 134.

**1872.** Bird & Michle, pier extension; **73**, 260.

**1873.** W. Nichols, pier extension, **73**, 260.

**1874.** W. L. Smith, pier extension, **76**, 244.

**1875.** T. L. Rosser & Co., pier extension, **75**, 244; **76**, ii, 464.

**1877.** R. M. Steel, pier extension, **77**, 902.

**1878.** H. S. Dale, pier extension, **79**, 1601.

**1879.** H. S. Dale, materials and labor, **80**, 2010. Closed before completion, **80**, 2009.

**1880.** N. G. Dodge, dredging, 15 cents per c. y., **81**, 2201.

**1882.** Dewar & Wing, pier construction, **83**, 1808. Green Bay Dredge & Pile Driver Co., dredging, 24 cents per c. y., **83**, 1809.

**1886.** D. Dake, materials, **86**, 1758.

**1887.** L. E. Allen, repair and extension of pier, **87**, 2179.

**1889.** Truman & Cooper, breakwater construction, $8,081.58, **89**, 2168.

**1891.** Gaylord & Wing, timber, plank, and hemlock, $18, $15, and $10 per M f. B. M.; G. W. Crouter, bolts, spikes, and nails, 3 cents per pound; F. A. Hagen, stone, $2.24 per cord, **91**, 2675.

**1892.** F. S. Chandler, dredging, 14 cents per c. y., $7,000, **93**, 2907.

**1895.** D. A. & Wm. McLeod, pier extension, $21,188.66, **95**, 2815.

**1896.** W. A. Starke, dredging, **97**, 2939.

**1897.** N. J. Gaylord, pier repairs, $7,417.89, **97**, 2941.

**1898.** R. B. Rice, pier repairs, $2,846.98, **98**, 2531.

**1899.** Greens Dredging Co., dredging, **99**, 2946.

**1900.** R. Love, extension and repair of piers (removing old work, dredging, piles, timber, ironwork, stone filling), $24,831.65. Greens Dredging Co., dredging. **1900**. 3927.

**Engineers.**

CHIEF OF ENGINEERS. Reports **66**, 2, 5, ii, 41, iii, 10, 35; **67**, 20, 26; **68**, 35; **69**, 30; **70**, 39; **71**, 38; **72**, 36; **73**, 36; **74**, 42; **75**, 47; **76**, 100; **77**, 105; **78**, 120; **79**, 161; **80**, 214; **81**, 290; **82**, 285; **83**, 292; **84**, 294; **85**, 315; **86**, 310; **87**, 278; **88**, 252; **89**, 294; **90**, 265; **91**, 337; **92**, 322; **93**, 278; **94**, 351; **95**, 386; **96**, 342; **97**, 432; **98**, 421; **99**, 501; **1900**, 565.

BOARD OF ENGINEERS. Convened July 20, 1882, at Grand Rapids, Mich., by S. O. No. 65, C. of E., 1882, to report upon modification of crib superstructure as proposed by Maj. Heap. Report, **83**, 1811. (Majs. Houston, Smith, and Benyaurd.)

ENGINEERS IN CHARGE:

Capt. G. G. Meade, 1859, **66**, 33.

Col. T. J. Cram, 1864–65, **66**, 2, 5. Report, **66**, 13, 32.

Maj. J. B. Wheeler, 1866–69. Reports, **66**, iv, 91, 94, 98; **67**, 117, 252, 258; **68**, 135.

Capt. F. U. Farquhar, 1869–72; **69**, 85, 101; **70**, 128; **71**, 132; **72**, 176.

Capt. S. M. Mansfield, 1872–79. Reports, **72**, 185; **73**, 260; **74**, 174; **75**, 244; **76**, ii, 464; **77**, 902; **78**, 1201; **79**, 1601.

Maj. F. Harwood, 1880–82. Reports, **80**, 2009; **81**, 2200.

Maj. D. P. Heap, 1882–83. Reports, **82**, 2283; **83**, 1810.

Capt. D. W. Lockwood, 1883–87. Reports, **83**, 1807; **84**, 1973; **85**, 2068; **86**, 1757; **87**, 2179.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1901.

Maj. W. Ludlow, 1889–93. Reports, **89**, 2167; **90**, 2612; **91**, 2674; **92**, 2318; **93**, 2905.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94**, 2230; **95**, 2813; **96**, 2712; **98**, 2529.

Capt. C. McD. Townsend, 1897. Report, **97**, 2929.

Capt. C. Harding, 1899—. Reports, **99**, 2944; **1900**, 3925.

ASSISTANTS:

Capt. A. Mackenzie. Reports, **67**, 117; **68**, 136.

Lt. E. A. Woodruff, **70**, 39.

F. W. Lehnartz. Report, **1900**, 3925.

**Estimates.** (See *Plans* and *Projects.*)

Col. Cram, pier extension and dredging, $88,541, **66**, 36.

Maj. J. B. Wheeler, sheath piling and pier extension, $68,756.60, **66**, iv, 95. Pier extension and dredging, $92,830.50, $34,388.50, **67**, 258, 259. Completion, $146,000, **67**, 117; **68**, 35.

Maj. F. U. Farquhar, increasing length of piers and the depth of water, $60,000; completion, $56,000, **71**, 132; **72**, 36.

Capt. Mansfield, dredging, $10,000, **72**, 185. To increase the length of the piers and dredging, $40,536.58, **79**, 162, 1601.

**Operations.**

**1867–68.** Close piling completed; 315 f. sheath piling; cribs refilled; superstructure built; 117,573 c. y. dredged; 514 l. f. south pier built, **68**, 35, 135; **76**, ii, 466.

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[a] Annulled, **72**, 176.

**FRANKFORT (AUX BECS SCIES) HARBOR, MICH.**—Continued.

**1868–69.** 382 cords of stone and 100 cords of brush put in piers; 12,641 c. y. dredged, **69**, 86; **74**, 174.

**1869–70.** 26,246 c. y. dredged; 320 l. f. north pier built, **70**, 39, 128; **74**, 175.

**1870–71.** 210 l. f. of wings built; dredging; 64 l. f. north pier built, **71**, 38, 132; **74**, 175.

**1871–72.** 64 l. f. superstructure built; 64 l. f. north pier built; 64 l. f. south pier built, **72**, 36, 176; **74**, 175.

**1872–73.** Pier extension; 65 l. f. south pier built, **73**, 36, 260.

**1873–74.** Pier extension; 150 l. f. south pier built, **74**, 42, 174.

**1874–75.** Dredging; 2,400 c. y. removed; 50 l. f. south pier built, **75**, 47, 244.

**1875–76.** Superstructure built; 18,195 c. y. dredged; 100 l. f. north pier built, **76**, 100, ii, 464.

**1876–77.** Repairs, **77**, 902.

**1877–78.** Old work refilled with stone; 50 l. f. south pier built, **78**, 120, 1201.

**1878–79.** Pier extension; 50 l. f. north pier built; 50 l. f. south pier built, **79**, 161, 1601.

**1879–80.** 13,350 c. y. dredged, **80**, 2009.

**1880–81.** 13,500 c. y. dredged, **81**, 2200.

**1881–82.** 100 l. f. crib work sunk in extension of south pier; cribs at outer end of south pier leveled up and superstructure built; 77 cords of stone placed in superstructure, **82**, 2283. Plan by Maj. Heap, 1883, for modified crib superstructure, **83**, 1808, 1810, 1811.

**1882–83.** Work on modified superstructure completed; 10,028 c. y. dredged; 50 l. f. of crib work added to south pier, **83**, 1808.

**1883–84.** Modified superstructure placed on end crib of south pier, **84**, 1973.

**1884–85.** 337 l. f. revetment on north side of channel and 187 l. f. on south side rebuilt, **85**, 2068.

**1886–87.** 396 l. f. north revetment completed; 230 f. south revetment repaired; south pier extended 50 f., **87**, 2179.

**1889–90.** South pier extended 100 f., **90**, 2612.

**1890–91.** 3,900 c. y. dredged, **91**, 2674.

**1891–92.** 22,770 c. y. dredged; repairs to piers and revetment, **92**, 2318.

**1892–93.** 37,106 c. y. dredged and gauge reading made, **93**, 2906.

**1893–94.** General repairs in progress and 6,933 c. y. dredged, **94**, 2231.

**1894–95.** 16,175 c. y. dredged and pier-extension work in progress, **95**, 2814.

**1895–96.** Pier extension continued, **96**, 2714.

**1896–97.** Pier extension completed and minor repairs made; 37,593 c. y, dredged, **97**, 2939.

**1897–98.** Minor repairs made to old piers and two unserviceable parts rebuilt, **98**, 2529.

**1898–99.** Completion of repairs to south pier; filling of various parts of piers with stone; 25,831 c. y. dredged, **99**, 2944.

**1899–1900.** 17,457 c. y. dredged; extension and repair of north pier and repair of south pier in progress, **1900**, 3925.

**Physical characteristics.**
Annual shoaling, **1900**, 3925.

**Plans.** (See *Estimates* and *Projects.*)
By Capt. Farquhar, to change the pier construction from crib to pile work, **69**, 102. To extend the piers 390 f. and dredge to 14 f., **70**, 129.

**Private (corporate) work.**
Two pile piers, filled with cord-wood and stone, extending into the lake 600 f., built by a company for harbor improvement, cost $16,000, **66**, 33.

In 1896 the Toledo & Ann Arbor Railway Co. received permission from the Secretary of War to add 400 f. to the south pier extension under the supervision of the Engineer officer in charge of the district, **96**, 2714; work done in 1897, **97**, 2939.

**Projects.** (See *Estimates* and *Plans.*)
By Col. Cram, 1866, dredging new outlet through strip of land separating Lake Aux Becs Scies from Lake Michigan, and building two parallel piers 200 f. apart, extending from 12-f. soundings in the inner lake to same depth in Lake Michigan; estimate, $88,541, **66**, 34, 36. Amended in 1875 and in 1879 to $254,196, **81**, 2201; **87**, 2179.

By Maj. J. B. Wheeler, sheath piling and refilling cribs with stone, **66**, iv, 95. Increasing length of piers and dredging, **67**, 117.

By Capt. Mansfield, to extend the south pier farther into the lake than the north, **73**, 261. For additional pier extension, **79**, 161, 1601.

By Maj. Harwood, 1881, completion of improvement by dredging, and 550 l. f. of pier extension; estimate, $100,000, **81**, 2201.

The act of 1896 authorized a channel depth of 18 f., **97**, 2939.

**Surveys.**
By Lt. O. M. Poe, 1859, **66**, 33.

By W. H. Hearding, **67**, 117, 126; **68**, 137.

Soundings taken, 1872, **76**, ii, 467; **77**, 902.

MAPS. **82**, 2284; **83**, 1808; **84**, 1973.

## FRANKLIN. (See *Allegheny River.*)

## FRANKLIN CITY, VA., TO CAPE CHARLES, VA. (Internal waterway from). (See *Chincoteague Inlet.*)

**Commerce.**

Not sufficient to warrant improvement asked for, **95**, 1159.

Description of, **95**, 1161.

**Engineers.**

CHIEF OF ENGINEERS. Report, **95**, 151.

ENGINEER IN CHARGE. Maj. W. F. Smith, U. S. Agent, 1895. Report, **95**, 1158.

ASSISTANT. A. Stierle. Report, **95**, 1159.

**Physical characteristics.**

Description of, **95**, 1159.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made under the direction of Maj. Smith, 1894 (see *Commerce*), **95**, 1159.

## FREDERICKSBURG. (See *Rappahannock River, Va.*)

## FREEDOM. (See *Ohio River.*)

## FREEDOM AND ROCHESTER, PA. (Ice harbor). (See *Ohio River at Rochester and Freedom, Pa.*)

## FREEPORT, CHANNEL CONNECTING, WITH GREAT SOUTH BAY, N. Y.

**Commerce.**

Chiefly in oysters, **93**, 1137.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 118.

ENGINEER IN CHARGE. Capt. T. L. Casey, 1893. Report, **93**, 1136.

**Physical characteristics**

Description of, **93**, 1136.

**Surveys.**

Examination ordered by act of July 13, 1892, made by Capt. Casey, 1892 (report unfavorable), **93**, 1136.

## FRENCH BROAD[a] AND LITTLE PIGEON RIVERS, N. C. AND TENN.

| Part: | Appropriation. |
|---|---|
| A—French Broad River, N. C. and Tenn | $30,000 |
| B—French Broad River, N. C | 13,000 |
| C—French Broad and Little Pigeon rivers, Tenn | 80,000 |
| Total | 123,000 |

### Part A.—French Broad River, Tenn. and N. C.

**Appropriations.**

1876, $10,000, **76**, 140; **77**, 66, 368.
1878, 15,000, **78**, 74, 523.
1879, 5,000, **79**, 88, 649

Total, 30,000

**Commerce.**

Unimportant, **71**, 63, 491; **75**, 818; **76**, 720.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 32, 65; **71**, 63; **75**, 78; **76**, 87; **77**, 66; **78**, 74; **79**, 87.

ENGINEERS IN CHARGE:

Maj. G. Weitzel, 1870. Report, **71**, 491.

Maj. W. McFarland, 1875–77. Reports, **75**, 817; **76**, 718.

S. T. Abert, U. S. C. E., 1877–81. Reports, **77**, 368; **78**, 522, 525; **79**, 648.

ASSISTANTS:

Lt. M. B. Adams. Report, **71**, 491.

R. C. McCalla. Reports, **75**, 818; **76**, 720.

**Operations.**

Early operations, **71**, 492, 493.

History of operations, **79**, 648.

**1877–78.** Removal of snags, etc., and quarrying rock for wing dams, **78**, 74, 537.

**1878–79.** Dredging, and constructing wing dams, **79**, 87, 648.

**Physical characteristics.**

Description, **71**, 491; **75**, 819; **76**, 721; **78**, 528.

**Plans.** (See *Projects.*)

By Lt. Adams, 1870, rendering the river navigable, Danbridge to mouth, with dams at various shoals; estimate, $150,000, **71**, 493, 494.

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[a] Survey—Report July 15, 1832. (H. Doc. No. 482, 55th Cong., 2d sess.)

## FRENCH BROAD AND LITTLE PIGEON RIVERS, N. C., AND TENN.—Continued.

### Part A.—French Broad River, Tenn. and N. C.—Continued.

By R. C. McCalla, 1875, 2½-f. channel, Brevard to Buncombe County, by removal of loose rock, bowlders, etc.; estimate $29,687.50; revised by Maj. McFarland to $41,610, **75**, 818, 820.

By Maj. McFarland, 1876, 2½-f. channel, Henderson County line to Holston River, by wing dams on upper and lower sections and locks and dams on middle section; estimate, upper section, $125,000; lower section, $150,000, **76**, 719.

By S. T. Abert, 1878, channel, Brevard to Asheville: 1st, with French movable dams, $82,816.20; 2d, American system of locks and dams, $78,290; 3d, wing dams and excavations, $45,530, **78**, 534, 538.

**Projects.** (See *Plans.*)

By S. T. Abert, 1878, 2½ f. of water, by removing snags and constructing groins and wing dams; estimate, $45,500, **78**, 74, 527, 538; **79**, 648.

**Surveys.**

By Lt. M. B. Adams, 1870, under direction of Maj. Weitzel. Report, **71**, 491.

By R. C. McCalla, 1874–75, under direction of Maj. McFarland. Report, **75**, 817, 818. In 1875. Report, **76**, 718, 720.

By S. T. Abert, 1877. Report, **78**, 522, 525.

### Part B.—French Broad River, N. C.

**Appropriations.**

1880, $3,000, **80**, 793.
1881, 5,000, **81**, 980.
1882, 5,000, **82**, 1059.

Total, 13,000

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 117; **81**, 157; **82**, 153; **83**, 160; **84**, 162; **85**, 152; **86**, 147; **87**, 113; **88**, 116; **91**, 280.

ENGINEERS IN CHARGE:

S. T. Abert, U. S. Agent, 1878–88. Reports, **80**, 791; **81**, 978; **82**, 1057; **83**, 832; **84**, 1002; **85**, 997; **86**, 929; **87**, 958; **88**, 843.

Lt. Col. J. W. Barlow, 1891–92. Report, **91**, 2261.

**Operations.**

History of operations, **80**, 791.

**1879–80.** Reef at Little Buck Shoals removed by blasting and dredging; 14 crib-work wing dams completed; banks protected by brush and stone; two scows built, **80**, 792.

**1880–81.** 575 c. y. rock blasted; 657 c. y. rock removed; 2,215 c. y. sand and gravel dredged; 170 logs, snags, and trees removed, **81**, 980.

**1881–82.** Dredging and removal of obstructions continued; wing dams built and repaired, **82**, 1058.

**Projects.**

By S. T. Abert, 1878, channel 35 f. wide and 2½ f. deep, Brevard to Big Buck Shoals, with wing dams, dredging, and rock removal; estimate, $45,500, **78**, 74, 537, 538; **79**, 648; **80**, 791; **87**, 958; **88**, 884.

By S. T. Abert, 1883, continuing the improvement Smith's bridge to foot of Long Shoal, by rock removal and dredging; estimate, $76,000. **83**, 835; **85**, 998; **87**, 958; **88**, 884.

**Surveys.**

Examination of river, 1882, **82**, 1058.

Survey from Smith's bridge to foot of Long Shoal, 1883, **83**, 832.

### Part C.—French Broad and Little Pigeon rivers, Tenn.

**Appropriations.**

1880, $10,000, **80**, 1680.
1881, 3,500, **81**, 1862.
1882, 5,000, **82**, 1850.
1884, 3,500, **84**, 1650.
1886, 6,000, **86**, 1521.
1888, 10,000, **88**, 1603.
1890, 10,000, **90**, 2129.
1892, 15,000, **92**, 1924.
1894, [a]7,000, **95**, 2317.
1896, 5,000, **96**, 2055.
1899, 5,000, **99**, 2302.

Total, [a]80,000

**Commerce.**

In 1893 commerce was increasing, and the stream was of vital importance, especially as a means of communication, to the adjacent country, **93**, 2386. Country adjacent rich in minerals, etc., **97**, 2310.

The total value of freight carried on French Broad River during the calendar year 1899, $779,705.10, more than ten times the amount expended on the river since improvement was begun by the United States in 1880, **1900**, 464.

Description of, **1900**, 3031.

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[a] See *Projects*.

## FRENCH BROAD AND LITTLE PIGEON RIVERS, N. C. AND TENN.—Continued.

### Part C.—French Broad and Little Pigeon rivers, Tenn.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 187; **81**, 252; **82**, 246; **83**, 254; **84**, 254; **85**, 276; **86**, 268; **87**, 231; **88**, 208; **89**, 243; **90**, 219; **91**, 280, 285, 2287; **92**, 268; **93**, 301, 302; **94**, 276, 277; **95**, 314, 315: **96**, 272, 273; **97**, 352; **98**, 344, 345; **99**, 406; **1900**, 463, 468.

ENGINEERS IN CHARGE:

Maj. W. R. King, 1880–86. Reports, **80**, 1679; **81**, 1861; **82**, 1848; **83**, 1862; **84**, 1650; **85**, 1765.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86**, 1520; **87**, 1751; **88**, 1602; **89**, 1831; **90**, 2127; **91**, 2261, 2287.

Lt. Col. H. M. Robert, 1892. Report, **92**, 1922.

Capt. J. Biddle, 1893–94. Reports, **93**, 2383; **94**, 1797.

Capt. T. A. Bingham, 1895. Report, **95**, 2313.

Capt. D. C. Kingman, 1896–. Reports, **96**, 2051; **97**, 2308, 2310; (Maj.), **98**, 1937; **99**, 2300; **1900**, 2944, 3018.

ASSISTANTS:

R. R. Thacher. Reports, **96**, 2056; **98**, 1941.

G. T. Nelles. Report, **1900**, 3025.

J. E. Hall. Report, **1900**, 3052.

**Operations.**

**1880–81.** 520 c. y. gravel dredged, 957 c. y. rock quarried, 300 c. y. earth embankment and 575 l. f. crib-dams built, and 1,250 l. f. old (State) dams repaired, **81**, 1861.

**1881–82.** 5,282 c. y. rock put into 25 dams; bowlders and gravel removed from the channel, **82**, 1849.

**1882–83.** 1,386 c. y. stone quarried; 3,871 c. y. riprap dams built; bowlders, snags, and trees removed from channel, **83**, 1494.

**1883–84.** No operations for lack of funds, **84**, 1650.

**1884–85.** 164 c. y. rock blasted; 569 c. y. gravel and 374 bowlders excavated; 795 c. y. rock quarried and 468 c. y. rock placed in dams, **85**, 1765.

**1885–86.** Riprap dam at Sewee Shoals completed, **86**, 1521.

**1886–87.** Repair to dams at Fains Island, **87**, 1751.

**1887–88.** 37 snags, 112 c. y. solid and loose rock, and 650 c. y. of earth removed from the channel; 1,726 c. y. riprap quarried, and 1,072 c. y. riprap placed in spur dams; work done by hired labor, **88**, 1602.

**1888–89.** 40 snags and 1,977 c. y. rock and gravel removed from the channel; 1,734 c. y. riprap placed in dams, **89**, 1832.

**1889–90.** 1,433 c. y. rock and gravel excavated, 240 trees cut from the banks, 104 l. f. of cofferdam built, 240 c. y. riprap quarried, and 1,523 c. y. of same built into dams, **90**, 2129.

**1890–91.** 195 c. y. loose rock removed from the channel at Bryants Shoals, 495 c. y. sand quarried, and 195 c. y. of riprap dam built, **91**, 2263.

**1891–92.** 6,000 c. y. stone used in construction of 3,492 l. f. of wing dams, **92**, 1924.

**1892–93.** Bank revetted with stone, spur dam raised, some obstructions removed, dams strengthened, and small, light-draught steamer built, **93**, 2385.

**1893–94.** 1,803 c. y. old dams repaired and extended, 1,390 c. y. riprap dams built, and some obstructions removed at Hanging Rock shoals and other points, **94**, 1799.

*Little Pigeon River:* Some obstructions removed, and nearly 1,000 c. y. dams built and extended, **94**, 1800.

**1894–95.** Work at Hanging Rock shoals continued, and begun at Zimmermans Ford; fleet repaired, **95**, 2315.

**1895–96.** 2,642 c. y. riprap dam built in repairs, etc., rock and other material excavated, some obstructions removed, banks riprapped, and crib constructed at Hanging Rock and Fains Island shoals, **96**, 2053.

*Little Pigeon River:* 363 c. y. stone placed in dams, and 360 c. y. excavated from channel, **96**, 2055.

**1897–98.** About 5,000 c. y. dredged and placed in repairs to dams, training walls, etc., at Hanging Rock shoals and other points, **98**, 1939.

*Little Pigeon River:* Nearly 500 c. y. dredged at the mouth, and some of it used for riprapping, etc., **98**, 1940.

**Physical characteristics.**

Description of, Little Pigeon River, **91**, 2287; **94**, 1800; **99**, 2301; **1900**, 2947.

Description of, French Broad River, **99**, 2300; **1900**, 3019.

Ice, etc., damaging works, **95**, 2316.

At Fains Island, survey made 1895–96 disclosed 2½ f. where 1½ existed before, **96**, 2053.

The great slope of the Little Pigeon River subjects it to sudden and violent freshets that bring down coarse gravel and bowlders, tending to re-form the two obstructing bars, **1900**, 465.

The area drained by the French Broad River about 5,600 square miles, **1900**, 3022.

Description of; shoals, soundings, and discharge observations, **1900**, 3038, 3052.

## FRENCH BROAD AND LITTLE PIGEON RIVERS, N. C. AND TENN.—Continued.

### Part C.—French Broad and Little Pigeon rivers, Tenn.—Cont'd.

**Projects.**

By Lt. Adams, 1870, channel 2½ f. deep at ordinary low water from Leadvale to the mouth, 90 miles, with wing dams and by removing snags and obstructions; estimate, $150,000, **71**, 493, 494; **80**, 187, 1680; **86**, 1520; **91**, 2263.

Act of 1892 allotted $1,000 for removal of bar in Little Pigeon River near the mouth, **93**, 2385; **94**, 1800. Act of 1894 allotted $1,000, **95**, 2317.

Act of Mar. 3, 1899, made provision, from appropriation for Tennessee River between Chattanooga and Riverton, for a survey of French Broad River, from Leadvale to its mouth; $3,600 allotted, **99**, 2301.

Of the $5,000 appropriated by act of Mar. 3, 1899, for French Broad River, $2,000 was allotted, to be used in connection with allotments from the appropriation for Clinch River, and Tennessee River above Chattanooga, for the purchase of a dredge with dump scows, **99**, 2301.

Maj. Kingman estimated, 1900, it would cost $278,052.50 to improve French Broad and Little Pigeon rivers, **1900**, 3019.

**Surveys.**

Examination Little Pigeon River ordered by act of Sept. 19, 1890; made, 1891, under direction of Lt. Col. Barlow (report unfavorable), **91**, 2288.

Fains Island. (See *Physical characteristics.*)

Survey of French Broad River, in Tennessee, ordered by act of Mar. 3, 1899, made, 1900, under direction of Maj. Kingman (report favorable), **1900**, 3019.

## FRENCH CREEK. (See *Allegheny River, Pa. and N. Y.*)

## FRENCHS BEACH HARBOR, ME.

**Commerce.**

Description of, **93**, 728.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 37.

ENGINEER IN CHARGE. Lt. Col. P. C. Hains, 1892–93. Report, **93**, 728.

**Physical characteristics.**

Description of, **93**, 729.

**Surveys.**

Examination ordered by act of July 13, 1892, made by Lt. Col. Hains, 1892 (report unfavorable), **93**, 728.

## FUCA STRAIT, WASH. (See *Pacific Coast, Harbor of Refuge; Port Orford*).

## FULTON. (See *Red River, Tex., Ark., and La.*)

## FUSILIER BAYOU, LA.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 197; **82**, 194.

ENGINEERS IN CHARGE:

Maj. C. W. Howell, 1880–81. Report, **82**, 1333.

Maj. A. Stickney, 1881. Report, **82**, 1419.

ASSISTANT. H. C. Collins. Report, **82**, 1419.

**Physical characteristics.**

Description of, **82**, 1419.

**Plans.**

Bayou Fusilier, except for the improvement of Bayou Teche, useless to navigation, **82**, 1419.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 146, examination made under direction of Maj. Howell, 1881, **82**, 1419.

## GALENA RIVER, ILL.

**Appropriations.**

| | | |
|---|---|---|
| 1878, | $30,000, | **78**, 98. |
| 1879, | 12,000, | **79**, 133. |
| 1880, | 12,000, | **80**, 1549. |
| 1881, | 12,000, | **81**, 1728. |
| 1890,[a] | 100,000, | **90**, 3673. |
| Total, | 166,000 | |

**Commerce.**

Important, **74**, 290, 293, 294, 295; **79**, 1149.

Railroad connections, **74**, 294.

**Contracts.**

**1878.** H. S. Brown, dredging, 17 to 25 cents per c. y., **79**, 1146, 1148.

**1879.** H. S. Brown, dredging, **80**,

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[a] See *Galena River, operating and care.—Projects.*

## GALENA RIVER, ILL.—Continued.

1549. Whitney & Son, dredging, **80**, 1549.

**1881.** Whitney & Son, dredging, **81**, 1728. Informal agreement with Whitney & Son and H. S. Brown, dredging, **81**, 1727.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 51; **74**, 58; **78**, 98; **79**, 132; **80**, 176; **81**, 237; **82**, 235.

ENGINEERS IN CHARGE:

Maj. F. U. Farquhar, 1873–79. Reports, **74**, 289; **78**, 724; **79**, 1146.

Capt. A. Mackenzie, 1880–82. Reports, **80**, 1548; **81**, 1727; **82**, 1791.

ASSISTANTS:

J. D. Skinner. Report, **74**, 291.

W. L. Kidder and J. C. McElherne, inspectors, **79**, 1147.

M. Meigs. Report, **82**, 1792.

**Estimates.** (See *Plans* and *Projects.*)

By J. D. Skinner: 1st, 6-f. channel throughout, $459,141; 2d, 4-f. channel throughout, $233,233; 3d, modification of first and second, $377,014, **74**, 290, 292.

**Operations.**

**1878–79.** By the removal of 100,975 c. y. by dredging, channels of the following dimensions were obtained: 35 to 50 f. wide by 3 f. deep by 1,670 f. in length; 35 to 40 f. wide by 3 to 4 f. deep by 2.9 miles in length; 100 f. wide by 4½ f. deep by 1,700 f. in length; 60 f. wide by 4½ f. deep by 1,300 f. in length, **79**, 132, 1147.

**1879–80.** 72,902 c. y. dredged, **80**, 1548.

**1880–81.** Harbor dredged to low-water grade and cut made from above cut-off to woolen mill, **81**, 1727.

**1881–82.** 51,358 c. y. dredged, **82**, 1793.

**Physical characteristics.**

Description of, **74**, 289, 290, 291; **79**, 1146.

Discharge of river, **75**, 291.

**Plans.** (See also *Estimates* and *Projects.*)

By. J. D. Skinner, 1873, dredging, to obtain channel from 4 to 6 f. deep, **74**, 291, 292.

**Projects.**

By Maj. Farquhar, 1873, dredging the cut-off to a depth of 6 f. above and 4 f. below; closing of Harris Slough; also the construction of dams of dry masonry backed by earth across the three principal ravines, so as to intercept sediment from inflowing streams; estimate, $400,000, **74**, 290, 291, 292; **78**, 98; **80**, 1548.

**Surveys.**

Ordered, from mouth to Galena, **73**, 51.

Made by J. D. Skinner, **74**, 58, 289, 291.

Galena to junction with Mississippi River, 1879, **80**, 1548.

## GALENA RIVER, ILL. (Operating and care.)

**Appropriations.**[a]

| | |
|---|---|
| 1894, | $635.68. |
| 1895, | 6,000.00. |
| 1896, | 3,400.00. |
| 1897, | 8,588.20. |
| 1898, | 5,890.05. |
| 1899, | 3,226.87. |
| 1900, | 8,750.94. |
| Total, | 36,491.74. |

**Commerce.**

Large and important. (See each yearly report.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **94**, 263; **95**, 292; **96**, 254; **97**, 323; **98**, 316; **99**, 377; **1900**, 433.

ENGINEERS IN CHARGE:

Maj. A. Mackenzie, 1894–95. Reports, **94**, 1691; **95**, 2157.

Lt. Col. W. R. King, 1896–97. Reports, **96**, 1826; **97**, 2109.

Capt. C. McD. Townsend, 1898–. Reports, **98**, 1802; **99**, 2168; (Maj.) **1900**, 2752.

ASSISTANT: Lt. C. Keller. Report, **95**, 2157.

**Operations.**

**1894–95.** Dredging done and lock repaired, **95**, 2158.

**1896–97.** 30,375 c. y. dredged, **97**, 2109.

**1898–99.** New lock house built on the site of the old one, which had been destroyed by fire, **99**, 2168.

**1899–1900.** Ice house built, 42,600 c. y. dredged, and 2,240 c. y. brush used for retaining fence, **1900**, 2752.

**Physical characteristics.**

Necessity for dredging will forever recur, **97**, 2109.

**Projects.**

Act of 1890 authorized the city of Galena to complete the improvement of the river at the city, and to construct a dam

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[a] Expenditures under the permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## GALENA RIVER, ILL.—Continued.

rising not more than 12 f. above low water with a lock not less 280 f. long and 52 f. wide, $100,000 to be paid by the U. S. to the city when a channel had been opened and maintained one season to a depth of at least 3 f. and of a width sufficient to accommodate any raft or boat that would pass through the lock. This sum was paid in 1894 after a survey. The Corps of Engineers assumed charge on Mar. 12, 1894, under a project for the operation and care of the works, three men being employed. **94**, 1691.

By Lt. Col. Mackenzie, 1894, for dredging in Harris Slough and for repair of lock, the floor and miter sills of which were in bad condition, **95**, 2157.

**Surveys.**

Minor surveys, **95**, 2158; **1900**, 2752.

## GALIEN RIVER, MICH. (See *New Buffalo Harbor.*)

## GALLOPS RAPIDS, ST. LAWRENCE RIVER. (See *St. Lawrence River.*)

## GALVESTON. (See *Trinity River.*)

## GALVESTON BAY. (See *Brazos River and Galveston Bay.*)

## GALVESTON BAY TO SABINE LAKE.

**Appropriation.**

1872, $3,000 (allotted), **73**, 680.

**Commerce.**

Future, would not be unimportant, **73**, 677.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **72**, 62; **73**, 66.

ENGINEER IN CHARGE. Maj. C. W. Howell, 1872. Report, **73**, 677.

ASSISTANTS:

Lt. H. M. Adams, 1873. Report, **73**, 677.

J. S. Polhemus, 1873. Report, **73**, 678.

**Legislation.**

Subsidy of $7,500 per mile granted by county of Galveston to the Texas and Mississippi Canal and Navigation Co. to aid them in the construction of the canal, **73**, 677.

**Physical characteristics.**

Character of country along the line of proposed canal, **73**, 679.

**Plans.**

By J. S. Polhemus, canal, Galveston Bay to Sabine Lake, 50 f. wide at water surface and 6 f. deep; estimate, $645,236, **73**, 680.

**Surveys.**

Survey for ship canal, under direction of Lt. Adams, by J. S. Polhemus. Report, **73**, 677, 678.

## GALVESTON HARBOR, TEX.[a] (See *Gulf of Mexico.*)

**Appropriations.**[b]

| | | |
|---|---|---|
| 1870, | $25,000, | **70**, 61; **71**, 517. |
| 1871, | 20,000, | **71**, 65, 517. |
| 1872, | 31,000, | **72**, 555. |
| 1874, | 60,000, | **74**, 73, 722. |
| 1875, | 150,000, | **75**, 79. |
| 1876, | 142,000, | **76**, 581. |
| 1878, | 125,000, | **78**, 82, 607. |
| 1879, | 100,000, | **79**, 110. |
| 1880, | 175,000, | **80**, 1207. |
| 1881, | 250,000, | **81**, 1328. |
| 1882, | 400,000, | **82**, 1446. |
| 1886, | 300,000, | **86**, 1293. |
| 1888, | 500,000, | **88**, 1269. |
| 1890, | 500,000, | **90**, 1770. |
| 1891, | 600,000, | **91**, 1875. |
| 1892, | 450,000, | **92**, 1527. |
| 1893, | 1,000,000, | **93**, 1864. |
| 1894, | 600,000, | **95**, 1800. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1895, | 1,160,000,<br>200,000, | **95**, 1800.<br>**95**, 1800. |
| 1896, | 300,000,<br>840,000,<br>[c]50,000, | **96**, 1528.<br>**96**, 1528.<br>**96**, 1528. |
| 1897, | 500,000, | **97**, 1796. |
| 1899, | 50,000, | **99**, 1955. |

Total, 8,528,000

**Commerce.**

Value of improvement as obtained in 1885, **85**, 1451.

Draft of vessels passing outer bar, **85**, 1451.

Of great value, and rapidly increasing, because of works of improvement, **96**, 1527.

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[a] Examination.—Report (favorable) Sept. 30, 1853. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Statement of total appropriations, **78**, 82; **79**, 912. Retention of appropriations delays work in 1876 and 1877, **77**, 73. Method of making appropriations not conducive to economy, **77**, 73, 447.

[c] For dredging bar.

## GALVESTON HARBOR, TEX.—Continued.

**Contracts.** [a]

**1871–77.** Morris & Cumings, construction and delivery (within 100 working days) of a dredge, $25,000, **71**, 517, 523. J. H. Lynch, delivery of two dump scows, $5,600, **71**, 517. Sufficient data obtained, 1875, to offer work by contract, **75**, 867. Recommended, 1876, that work be not done by contract, **76**, 580; renewed, 1877, **77**, 448.

**1881.** T. K. Thompson, cordage; Shannon & Hyatt, brush; Gulf, Colorado and Santa Fe R. R., stone, **81**, 1327.

**1882.** Hitchcock & Byrnes, stone; A. M. Shannon, brush; H. Marwitz & Co. and A. Flake & Co., cordage; Burnett & Ross, cane; I. Heffron, handling stone, **82**, 1442, 1443; **83**, 1060, 1061, 1070.

**1887.** A. M. Shannon & Co., raising height of old south jetty, **87**, 1416.

**1888.** A. M. Shannon & Co., riprap jetty construction, $402,475, **89**, 1538.

**1890.** O'Connor, Laing & Smoot, construction of railway, including trestle, and furnishing sandstone, riprap, and granite blocks in place, $3,469,710, **91**, 1879.

**1893.** T. S. Marvel & Co., twin-screw propeller, $28,500, **93**, 1864.

**1894.** Bucyrus Steam Shovel and Dredge Co., self-propelling suction dredge, $86,000, **95**, 1801.

**1895.** J. W. Byrnes, constructing coal wharf, $6,000, **96**, 1528.

**Defense.**

Partial destruction of batteries on Pelican Spit, 1867, by erosive action of sea, **68**, 505, 509; protection necessary to prevent, **68**, 505, 509, 511, 517; obstructions placed in harbor by rebels, 1863, **68**, 508.

**Documents.** (Not published in reports.)

Capt. G. B. McClellan's report. Ex. Doc. 1853 and 1854, ii, 560; **68**, 504, 507.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **67**, 38; **68**, 55; **70**, 61; **71**, 65; **72**, 60; **73**, 65; **74**, 73; **75**, 79; **76**, 75; **77**, 73; **78**, 82; **79**, 109; **80**, 147; **81**, 199; **82**, 196; **83**, 201; **84**, 216; **85**, 226; **86**, 223, 1294; **87**, 189; **88**, 172; **89**, 203; **90**, 182; **91**, 231; **92**, 224; **93**, 252; **94**, 233; **95**, 261; **96**, 226; **97**, 292; **98**, 282; **99**, 338; **1900**, 384.

Instructions of, concerning survey, 1867; **68**, 498.

BOARDS OF ENGINEERS:

1864. To consider the practicability and probable cost of increasing depth of water in Galveston Bay and entrance, by plan submitted by Capt. Howell. (See *Projects.*) Board considered that two piers from Fort and Boliva Points will improve the outer and, incidentally, the inner bar, **74**, 737. Future extension of piers, aided by harrowing, probably necessary. In view of the novelty of the plan proposed, the Board recommended a trial of the plan at inner end of Fort Point; if successful, then a trial in most exposed position. Gabions should have covers and bottoms. **74**, 738. The auxiliary works within the bay to be delayed until practicability of plan has been demonstrated; revised estimate of cost of project, **74**, 739.

(Lt. Cols. Wright, Tower, and Newton and Capt. Howell.)

Capt. Howell, not fully concurring, submitted that he was more confident than the other members of the Board in the adequacy of construction, and considered his estimate adequate, **74**, 739.

Reconvened Jan. 7, 1875, to consider Capt. Howell's report in relation to progress and continuation of work. Board considered that the results obtained by experience of 1874 are not decisive, but that the full tests recommended in 1874 be carried out. A trial to be made with a single row of gabions (in connection with the method of two rows) in each tier. **75**, 869.

Reconvened Dec. 28, 1875, to reconsider the question of improvement and modification, if any, of plan adopted, **76**, 581. Review of the conclusions of 1874, **76**, 582. Board concluded that the two jetties recommended in 1874 would produce an important increase in the depths over outer bar, and recommended that the first part constructed be from Fort Point toward the main channel; that gabions be not definitely adopted for main works until more extended test, **76**, 583; that the channel caused by the storm of Sept., 1874, across island should be closed; that the gabions be placed on mats, previously sunk, **76**, 584.

Convened Aug. 9, 1879, to consider the improvement of the entrance to Galveston Harbor. Report, **80**, 1266. Board recommended that no more gabions be made, but that the 600 on hand be strengthened and used as a further trial of their value. They also suggested a trial of the Dutch system of jetty construction by use of alternate layers of mattress and stone, **80**, 1270, 1271.

Reconvened June, 1880. Report, **80**, 1221. The Board recommended the use of broad foundation mattress covered with brush and stone or concrete blocks, **80**, 1227, 1230. Observations by Board on mattress construction, **82**, 1452.

(Cols. Tower and Newton and Lt. Col. Gillmore.)

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[a] Tables showing kind and amount of stone used in jetties, and other items of expense, **93**, 1866; **94**, 1393; **95**, 1803; **96**, 1537; **97**, 1799, 1800; **98**, 1495–96.

## GALVESTON HARBOR, TEX.—Continued.

Convened Jan., 1886. Report, **86**, 1297. The Board recommended building up and completing the south jetty to crest of outer bar; building a north jetty to crest of outer bar; extending both jetties to the 30-foot curve in the Gulf; such dredging from time to time, in aid of tidal scour, as the rate of appropriation given might afford, **86**, 1292.

(Col. Duane and Lt. Cols. Abbot and Comstock.)

Convened at Philadelphia, Dec. 11, 1889, by S. O. No. 29, to examine and report upon the most eligible location for a deep-water harbor on the northwest coast of the Gulf of Mexico. Report, **90**, 1781.

(Lt. Cols. Robert, Gillespie, and Smith.)

ENGINEERS IN CHARGE:

Maj. M. D. McAlester. Reports, **67**, 363; **68**, 497.

Capt. C. W. Howell, 1871–80. Reports, **71**, 516; **72**, 554; **74**, 721; **75**, 846; **76**, 564; **77**, 446; **78**, 603; **79**, 909; **80**, 146.

Maj. S. M. Mansfield, 1880–86. Reports, **80**, 1204, 1231; **81**, 1326; **82**, 1441; **83**, 1059; **84**, 1295; **85**, 1449; **86**, 1291, 1311, 1315.

Maj. O. H. Ernst, 1886–90. Reports, **87**, 1415; **88**, 1265; **89**, 1535.

Maj. C. J. Allen, 1890–92. Reports, **90**, 1767; **91**, 1871; **92**, 1523.

Maj. A. M. Miller, 1893–97. Reports, **93**, 1861; **94**, 1389; **95**, 1797; **96**, 1523; **97**, 1793.

Maj. J. B. Quinn, 1898. Report, **98**, 1491.

Capt. C. S. Riché, 1899–. Reports, **99**, 1953, **1900**, 2308.

ASSISTANTS:

Lt. W. S. Stanton, **67**, 363. Report, **68**, 504.

Lt. H. M. Adams, **71**, 520. Report, **74**, 722.

Lt. J. B. Quinn. Report, **75**, 846.

Lt. C. E. L. B. Davis. Reports, **76**, 576; **77**, 449; **78**, 603; **80**, 1208, 1232.

H. C. Ripley. Reports, **74**, 726; **75**, 868; **76**, 577; **77**, 452; **78**, 604, 606; **80**, 1210, 1219, 1231; **82**, 1447; **83**, 1073; **84**, 1300; **88**, 1272; **89**, 1542.

R. B. Talfor, W. Thompson, J. C. Buchanan, R. Scott, **76**, 580.

W. H. Burke. Report, **81**, 1328.

W. A. Hinkle. Reports, **82**, 1450; **83**, 1071; **84**, 1299.

Lt. G. A. Zinn. Report, **88**, 1270.

Lt. W. C. Langfitt. Reports, **89**, 1538; **90**, 1770; **91**, 1879; **92**, 1527.

G. Bagnall. Reports, **90**, 1779; **91**, 1896.

E. M. Hartrick. Reports, **91**, 1890; **92**, 1529; **93**, 1865; **94**, 1391; **95**, 1801; **96**, 1536; **97**, 1798; **98**, 1494; **99**, 1956; **1900**, 2311.

Lt. W. V. Judson. Reports, **95**, 1801; **96**, 1529.

L. C. Sabin. Reports, **98**, 1497; **1900**, 2312.

F. Oppokofer. Report, **98**, 1505.

**Estimates.** (See also *Plans* and *Projects.*)

By Maj. McAlester, 1868, plan of closing San Luis Pass, $330,000, **68**, 501, 517. Dredging channel, 80 by 12 f., $10,952, **68**, 503, 517. System of jetties, composed of concrete blocks, intersecting Bolivar Channel from shoals of Pelican Island and Spit, $1,300,000, **68**, 515.

By Capt. Howell, 1873, improving the harbor with jetties and training walls, consisting of cement-covered gabions (see *Projects*), $1,259,446. Part recommended by Board of Engineers, 1874, $1,224,000, **74**, 734, 740; **78**, 82; **79**, 912.

By Board of Engineers, 1874, $1,759,401, **74**, 740; **79**, 912. Comparison by Capt. Howell of estimate of 1873 and of that of the Board of Engineers, 1874, with results of cost as determined by experience of 1874 and 1875, **75**, 865.

Revised estimate by Capt. Howell, 1875, $559,740, **75**, 866; **77**, 74; **78**, 82. Effect of changes in method and project on estimates, **77**, 447.

Cost of completion of existing project, $682,446, **79**, 110, 912.

**Legislation.**

Draft of an act to facilitate execution and to protect certain public works of improvement, **71**, 522.

**Operations.**

**1870.** Proposals for dredging rejected; ineffectual attempts to hire or purchase a dredge; authority given to build, **71**, 517. Temporary character of relief from dredging, **71**, 521.

**1871–72.** Suspended because depth on outer bar is as great as depth on inner; dredge transferred to other works, **72**, 60, 554.

**1873–74.** Confined to care of property, **74**, 724.

**1874–75.** Work began under project of Capt. Howell Sept., 1874; favorable results obtained, **75**, 79, 864. Unexpected results, **75**, 847, 858. Difficulty in obtaining material for gabions, **75**, 846. Method of conducting work; changes recommended, **75**, 849, 858. Necessity of cross jetties to check abrasion, **75**, 853. Cost per l. f. of jetty, gabions in two rows, $16.04, **75**, 848. Gabions in one row, $5.21, **75**, 863.

**1875–76.** General progress, **76**, 564, 577. Storm, disastrous effects of (Sept. 14, 1875), **76**, 75, 566, 570, 579, 583. Changes in details of gabions, **76**, 574. Work already done has given 16½ f. over

## **GALVESTON HARBOR, TEX.**—Continued.

inner bar, **76**, 580. Cost per l. f. of jetty, $6.12, **76**, 570.

**1876–77.** Suspended from July to Sept., 1876, by retention of appropriations, **77**, 73, 446, 449. General progress during year, **77**, 449, 453. Depths obtained over inner bar, 15¾ f. to 16¾ f., **77**, 452. Placing mats under gabions increases cost of single gabion, but obviates necessity of several rows, **77**, 447. Cost per l. f. gabionade on scow ready for position, $8.92, **77**, 447, 451.

**1877–78.** Work discontinued Nov., 1877, to June 12, 1878, from lack of appropriations; repairs to breakwater at Fort Point; extension of gabionade at Bolivar Point, **78**, 603, 605. Depth of water obtained by work done, **78**, 604.

**1878–79.** Gabionade at present extends 7,332 f.; has maintained 20 f. depth over outer bar, **79**, 109, 910. Résumé of past operations, **79**, 910.

**1879–80.** 2,278 l. f. added to Bolivar Gabionade, **80**, 1208. Placing of gabions discontinued and mats loaded with concrete blocks substituted, **80**, 1209, 1227. Description of gabion construction, **80**, 1232.

**1880–81.** Extension of south jetty with brush and cane mattress ballasted with concrete and stone, **81**, 1326, 1328, 1329; **82**, 1441.

**1881–82.** 111,393 c. y. of brush mattress and stone ballast placed in south jetty, **82**, 1442, 1445. Cost of jetty per c. y., $2.88, **83**, 1066.

**1882–83.** 107,555 c. y. of brush mattress and stone ballast placed in south jetty, **83**, 1060, 1066, 1071. Cost of jetty per c. y., $2.83, **83**, 1066.

**1883–84.** 38,204 c. y. of brush mattress and stone ballast placed in south jetty, **84**, 1296, 1299. Cost per c. y., $3.17 **84**, 1296; **85**, 1450; **86**, 1305.

**1886–87.** Preparations for resumption of work on south jetty, **87**, 1416.

**1887–88.** 4,550 l. f. of the old south jetty built up to 5 f. above m. l. w. under contract; 90,125 c. y. riprap stone blocks and clay used, **88**, 1266, 1272.

**1888–89.** 464 l. f. of shore branch of jetty built; jetty extended seaward 900 f., and 200 f. additional partly finished; 2,175 l. f. of trestle and railway built, **89**, 1536.

**1889–90.** South jetty extended 2,800 f. and partly completed for an additional 1,200 f.; rock work completed upon 8,559 l. f. of shore branch; railway trestle extended 428 f. beyond incomplete rock work, **90**, 1768, 1774.

**1890–91.** 10,969 c. y. of riprap and 4,320 c. y. block stone placed in south jetty, **91**, 1891. Rock work extended 350 f. and trestle and track 240 f., **91**, 1872

**1891–92.** 100,400 t. of riprap and 50,617 t. of granite blocks used in extension of south jetty 7,523 f., **92**, 1530.

**1892–93.** South jetty extended to a total length of about 32,829 f.; north, 3,600 f., **93**, 1863.

**1893–94.** North jetty extended to total length of about 16,000 f., **94**, 1390.

**1894–95.** North jetty extended to a total length of 22,500 f.; 11,000 f. of trestle on south jetty repaired, and 12,600 in course of construction; portion of south jetty with clay core raised; 68,071 c. y. dredged, **95**, 1798, 1799.

**1895–96.** South jetty completed to a total distance of 33,100 f.; north jetty, to 25,110 f. 213,596 c. y. dredged by contract, and 419,748 c. y. by Government dredge. Coal wharf built at Fort Point. **96**, 1525, 1526.

**1896–97.** South jetty completed to a total length of 34,800 f., with an apron 803 f. long at its outer end; north jetty, to 24,700 f. 806,646 c. y. dredged by Government dredge. **97**, 1794, 1795.

**1897–98.** North jetty extended to a total length of 25,907 f., with 307 f. of riprap apron. 562,976 c. y. dredged by Government dredge, **98**, 1492.

**1898–99.** 500,702 c. y. dredged, **99**, 1954.

**1899–1900.** 661,038 c. y. dredged, **1900**, 2308.

**Physical characteristics.**

Of Galveston Harbor, **68**, 507; **71**, 518; **74**, 723, 729; **75**, 846.

Pelican Spit, **68**, 504; **74**, 723, 729. Movement of, since 1851, **68**, 504, 508, 571. Cause of, **74**, 723, 730, 731.

Harbor, **68**, 501, 507.

Character of bottom, **74**, 729.

Rise and fall of tides, **68**, 502; **74**, 732; **86**, 1300. Physical changes, **86**, 1303.

Velocity of currents, **68**, 570; **74**, 728.

Presence of littoral currents, **71**, 519, 520; **74**, 723, 724, 728. Uncertainty of, **74**, 736, 738.

Table of velocity and direction of wind, 1874 and 1875, **75**, 862.

Elevation of water during gale of Sept., 1875, **76**, 578.

Teredo navalis, action of, on piles, **68**, 512; **86**, 1312, 1314, 1316. Cement protects gabions against, **76**, 570.

Peculiar formation at Fort Point, **77**, 449.

Description of Galveston Bay, **86**, 1297.

Description of Galveston Bar, **86**, 1298.

Area of cross-sections at Bolivar Bar, **80**, 1213.

Wind diagrams and observations, **80**, 1220; **86**, 1299.

Tidal observations, **88**, 1270, 1276; **89**, 1536, 1538, 1542; **90**, 1770, 1773; **95**, 1801; **96**, 1529; **98**, 1493, 1505.

**GALVESTON HARBOR, TEX.**—Continued.

Effect of storms upon height of tide, **88**, 1274.

Description of the passes and harbors on northwest coast of the Gulf of Mexico, **90**, 1783.

Discussion of the relative advantages for the location of a deep-water harbor or outer harbor off Padre Island, mouth of Brazos River, Cedar Bayou, Corpus Christi Pass, Brazos Santiago entrance, San Luis Pass, Pass Cavallo, Sabine Pass, Aransas Pass, and Galveston entrance, **90**, 1783, 1788.

Depths increasing as an effect of the works of improvement, **93**, 1863; **97**, 1796.

Structure-damaging storms, **96**, 1526; **97**, 1796; **98**, 1493.

Subsidence of jetties, **96**, 1535; **97**, 1801.

**Plans.** (See *Estimates* and *Projects.*)

Of Maj. McAlester, 1868, closing San Luis Pass with a dam, thereby increasing the harbor reservoir 36 square miles, and depending on scouring effect of ebb tides, **68**, 501, 516. Results not proportionate to cost, also action uncertain, hence objected to, **68**, 502. For a system of jetties intersecting Bolivar Channel from the shoals of Pelican Island and Spit; jetty formed of concrete blocks, laid without cement, **68**, 512. Objections to, enormous cost, defective action of, insecurity of, danger to water front of city, **68**, 500. Of pile jetty commenced by city of Galveston, 1869 (see *Private work*).

**Private (city) work.**

Pile jetty commenced by city, 1869, at Fort Point, and (intended to deepen inner bar) now about 1 mile long, **74**, 723; **75**, 858; **79**, 910. Partially swept away by storm of Sept., 1875, **76**, 566. $100,000 appropriated in 1883 by city to continue work, **83**, 1063, 1068; **84**, 1296.

**Projects.** (See *Contracts; Estimates*, and *Plans.*)

By Maj. McAlester, 1868, inner bar, dredging a channel 80 by 12 f., **68**, 503, 517; **71**, 517. Unable to profitably contract; authority given to build a dredge, **71**, 517. Temporary character of relief given, **71**, 521. Project for dredging not worthy of consideration, **74**, 732.

By Capt. Howell, 1871, entrance to bay and harbor, to admit vessels drawing 18 f., **71**, 518. Breakwater along the crest of Galveston Bar, and jetties to extend the head of Galveston Island to "Middle Ground Breakers," **71**, 520. Breakwater to consist of concrete blocks on grillage foundation; jetties similar to, but of lighter construction, **71**, 521. Project abandoned on account of the absence of hitherto supposed littoral currents, **74**, 736.

From 1870 to 1872, inclusive, $76,000 was appropriated, expended in building and operating a dredge on the inner bar and in strengthening the Fort Point jetty, **71**, 517; **72**, 554; **74**, 724.

Capt. Howell, 1873–74, proposed the removal of the inner bar between Fort Point and Pelican Spit, and deepening the channel over the outer bar to 18 f.; it was proposed to effect the first by continuing the city dike to the edge of Bolivar Channel, and thereby secure sufficient contraction to scour the desired channel. The second was to be accomplished by prolonging the first dike seaward and by the construction of a parallel dike from Bolivar Point. In place of stone it was proposed to use gabions covered with hydraulic cement and filled with sand. **74**, 732, 736; **80**, 1221.

Considered by Board of Engineers, 1874–75; changes recommended, using single row of gabions placed on mats, **75**, 849, 869.

From 1874 to 1879, inclusive, $577,000 was appropriated under this project, resulting in a 20-f. channel over the inner bar, **80**, 147.

In 1879 a Board of Engineers recommended that no more gabions be made, and that those on hand be strengthened and used for further experiment; also that trial be made of the Dutch system of jetties composed of alternate layers of mattress and stone, **79**, 910; **80**, 1270.

In 1880 the Board of Engineers further recommended the use of broad foundation mattress covered with brush and stone or concrete blocks, **80**, 1227, 1230. Sketches of jetties as proposed, **80**, 1228. Estimated cost, including appropriation of 1880, $1,825,813, **81**, 1328. Least depth proposed over outer bar, **84**, 217; **85**, 1450; **86**, 1297.

The Board of 1886 recommended building up and completing south jetty to the crest of the outer bar, building a north jetty to crest of bar, and extending both jetties to the 30-f. curve in the Gulf; dredging from time to time, in aid of tidal scour, as the rate of appropriation given might afford, **86**, 1292.

Interval between outer ends of jetties to be 7,000 f., **86**, 1308. Depth to be obtained, **86**, 223, 1309, 1311. General plan of construction, **86**, 1310. Estimated cost, $7,000,000, in addition to $1,478,000 appropriated previous to 1886, or an aggregate of $8,478,000, **86**, 1311; **87**, 1416.

Maj. Miller estimated, 1896, it would require $250,000 additional to complete existing project, to cover cost of dredging, not considered in original estimate, **96**, 1527.

The Department, 1897, ordered that the outer ends of the jetties should be built up for 500 f. each, making their

## GALVESTON HARBOR, TEX.—Continued.

total length as follows: South jetty, 35,300 f.; north, 25,700 f., the first to have an apron 300 f. long and the second 307 f. long, **97**, 1794.

**Surveys.**

By U. S. Coast Survey, began June, 1867, **67**, 38, 363; **68**, 498, 505. Completed Apr., 1868, **68**, 55, 499. Changes determined by comparison of surveys, 1843, 1853, 1868, **68**, 508.

Survey of 1870, **70**, 520. Of 1872 and 1873, method of making, **74**, 726. Results of, and comparison with earlier, **74**, 723. Borings, method of making, by water jet, **74**, 724. Specimens of bottom obtained, **74**, 725.

Surveys of 1875–76, **76**, 577.

Resurvey of inner and outer bar; comparison of present and past condition, **78**, 606.

Of inner and outer bars, **79**, 911.

Previous to 1880, **80**, 1266.

Resurvey of harbor entrance. Made, 1888, under direction of Maj. Ernst, **88**, 1267, 1277; 1889, **89**, 1536, 1546; 1890, under direction of Maj. Allen, **90**, 1768, 1777.

Description of Galveston base line, **1900**, 2312.

MAPS.

**78**, 606; **80**, 1206; **82**, 1444; **83**, 1074; **84**, 1300; **88**, 1278; **89**, 1536; **90**, 1772, 1776; **91**, 1875, 1889; **92**, Atlas, 79, 80, 81; **93**, 1864; **94**, 1390; **95**, 1804; **96**, 1540; **97**, 1802; **98**, 1496; **99**, 1960.

Entrance, **87**, 1416.

Minor surveys (see each annual report).

Resurvey of the bay commenced in 1897–98, **98**, 1493, 1497.

## GALVESTON HARBOR TO TEXAS CITY, TEX. (Channel).

**Appropriations.**

1899, $250,000, **99**, 1962.

**Contracts.**

**1899.** Drake & Stratton Co., dredging, $250,000, **1900**, 2327.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99**, 339, **1900**, 386.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–. Reports, **99**, 1962; **1900**, 2326.

ASSISTANT. E. M. Hartrick. Report, **99**, 1963.

**Private (corporate) work.**

Texas City Terminal Co., 1895–96, dredged a channel 16 f. deep, **99**, 339.

**Projects.**

By Capt. Riché, 1899, for a channel 100 f. wide at bottom and 25 f. deep north of Pelican Island from Galveston Harbor to Texas City, Tex.; estimate, $500,000, **99**, 1962.

## GALVESTON ISLAND, TEX. (East end). (See *Galveston Harbor*.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 266; **96**, 231; **97**, 298.

ENGINEER IN CHARGE. Maj. A. M. Miller, 1895–97. Reports, **96**, 1558; **97**, 1813.

**Physical characteristics.**

Description of, **96**, 1558.

Erosion caused by violent storms, and consequent littoral movement of almost impalpable sand, **96**, 1558.

Effect of south jetty after extension at Galveston such as to almost if not quite prevent erosion at that point, **97**, 1813.

**Projects.**

In 1895 Maj. Miller estimated that to prevent erosion would cost $90,000 or $115,000 by two plans, **96**, 1558. (See *Physical characteristics.*)

**Surveys.**

Survey of the easterly end to determine the causes of its erosion and to obtain estimates for its prevention, ordered by act of Aug. 17, 1894, made, 1895, by Maj. Miller (see *Projects*), **96**, 1558. Further determinations and estimates called for by act of June 3, 1896; report (unfavorable) submitted by Maj. Miller, 1896, **97**, 1813.

## GALVESTON RIVER. (See *Sabine*, etc.)

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.

| Part. | Appropriations. |
|---|---|
| A. Galveston Bay Ship Channel | $859,016.85 |
| B. Buffalo Bayou | 228,750.00 |
| C. Part A and Part B continued | 300,000.00 |
| Total | 1,387,766.85 |

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.—Continued.

### Part A.—Galveston Bay ship channel, Tex.

(Including Buffalo Bayou, survey to Dollar Point, Red-Fish Bar Channel, channel between mouth of San Jacinto River and Bolivar Channel, channel between Red-Fish Bar and Morgans Point, and examination of obstructions, San Jacinto River.) (See also *Cedar Bayou Bar.*)

**Appropriations.**[a]

1872, [b]$10,000.00, **73**, 634.
1874, [b]10,000.00, **74**, 74.
1875, [b]10,200.00, **75**, 79.
1875, [c]25,000.00, **75**, 79.
1876, [c]72,000.00, **76**, 77.
1876, 10,000.00 (survey), **77**, 75.
1878, [d]75,000.00, **78**, 83.
1879, [d][e]80,000.00, **79**, 110.
1880, 50,000.00, **80**, 1238.
1881, 50,000.00, **81**, 1334.
1882, 94,500.00, **82**, 1457.
1888, 100,000.00, **88**, 1281.
1890, 40,000.00, **91**, 1909.
1890, [f]92,316.85, act Sept. 19.
1892, 40,000.00, **92**, 1539.
1894, 50,000.00, **95**, 1808.
1896, 50,000.00, **96**, 1544.

Total, 859,016.85

**Commerce.**

Important, **71**, 535; **73**, 65, 635; **75**, 873–875; **76**, 587, 588.

Tolls for passing ship channel at Morgans Point, **77**, 461.

Necessity of channel less than formerly and not called for by interests of commerce, **83**, 202, 1082.

Description of. Probable benefits of improvement to, apparently to be greater than expenditures. **96**, 1543.

**Contracts.**

**1875.** E. W. Cave, dredging, 17 to 25 cents per c. y., **75**, 872; **76**, 585, 586.

**1878.** G. C. Fobes & Co., dredging, 15⅞ cents per c. y., **79**, 110, 915, 918.

**1881.** J. E. Slaughter, dredging, 13.7 cents per c. y., **81**, 1333.

**1888.** G. C. Fobes, dredging, 11.3 cents per c. y., **88**, 1282. G. C. Fobes, dredging, 12½ cents per c. y., **89**, 1551.

**1893.** R. Moore Dredging Co., dredging, 24½ cents per c. y. ($56,350), **93**, 1875.

**1894.** C. & R. P. Clarke, dredging, 12½ cents per c. y. ($18,750), **95**, 1808.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 66; **73**, 65; **74**, 73; **75**, 79; **76**, 76; **77**, 74, 456; **78**, 83; **79**, 110; **80**, 147; **81**, 200, 1334; **82**, 196; **83**, 202, 1080; **84**, 217; **85**, 226; **86**, 224; **87**, 189; **88**, 173; **89**, 203; **90**, 183; **91**, 232; **92**, 225; **93**, 253; **94**, 234; **95**, 262; **96**, 227; **97**, 294; **98**, 283; **99**, 340; **1900**, 386.

BOARD OF ENGINEERS:

Convened Sept. 1, 1877, at New York City, to consider location of proposed ship channel through Galveston Bay. Recommended a line from Red-Fish Bar to the head of Bolivar Channel as the most advantageous. **77**, 467; **78**, 608. (Col. Tower, Lt. Cols. Wright and Newton, and Capt. Howell.)

Convened by S. O. No. 9, C. of E., 1883. Report, **83**, 1078. The Board reported it improbable that a channel of the proposed depth would be permanent through the Morgan Cut, **83**, 1081, 1082. (Maj. Mansfield; Capts. Damrell and Heuer.)

Convened at Galveston, Tex., Dec. 4, 1890, by S. O. No. 66, to report upon value of channel constructed by the Buffalo Bayou Ship Channel Co. in Galveston Bay. Report, **91**, 1910. (Col. Comstock, Maj. Allen, and Lt. Langfitt.)

ENGINEERS IN CHARGE:

Capt. C. W. Howell, 1871–80. Reports, **71**, 533; **73**, 634; **74**, 740; **75**, 870, 872, 874; **76**, 585; **77**, 455, 458, 459; **78**, 607; **79**, 912; (Maj.), **80**, 146.

Maj. S. M. Mansfield, 1880–86. Reports, **80**, 1236; **81**, 1332; **82**, 1456; **83**, 1075; **84**, 1303; **85**, 1454; **86**, 1322.

Maj. O. H. Ernst, 1886–90. Reports, **87**, 1417; **88**, 1279; **89**, 1548.

Maj. C. J. Allen, 1890–92. Reports, **90**, 1797; **91**, 1906; **92**, 1536.

Maj. A. M. Miller, 1893–97. Reports, **93**, 1872; **94**, 1396; **95**, 1806; **96**, 1542; **97**, 1803.

Maj. J. B. Quinn, 1898. Report, **98**, 1505.

Capt. C. S. Riché, 1899–. Reports, **99**, 1961; **1900**, 2325.

ASSISTANTS:

Lt. H. M. Adams, **71**, 66. Report, **71**, 534.

W. D. Duke, **71**, 535.

Capt. C. E. L. B. Davis, **79**, 106. Report, **79**, 916; **80**, 1236.

Lt. J. B. Quinn, **75**, 78. Report, **75**, 875.

J. C. Forsby, **76**, 586.

A. Cross, **76**, 586.

A. G. Blanchard, **76**, 586.

J. A. Hayward. Report, **77**, 459.

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[a] Total appropriations from 1824 to 1875, $45,000, H. Doc. 120, 44th Cong. 1st sess.
[b] Red-Fish Bar Channel.
[c] Channel between San Jacinto River and Bolivar Channel.
[d] Channel between Red-Fish Bar and Bolivar Channel.
[e] See proviso, **79**, 214.
[f] Paying Buffalo Bayou Ship Channel Co. for Morgan Cut and Canal.

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.—Continued.

### Part A.—Galveston Bay ship channel, Tex.—Continued.

H. C. Ripley. Report, **77**, 462.

E. M. Hartrick. Reports, **88**, 1282; **89**, 1551; **90**, 1800.

G. Bagnall. Reports, **91**, 1909; **92**, 1539.

D. Allen. Reports, **93**, 1875; **94**, 1398; **95**, 1808.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Adams, 1870, Galveston Bay: 1st, $3,443,113; 2d, $940,315; 3d, $382,017, **71**, 536.

By Capt. Howell, 1875, completion of a 9-f. channel through Red Fish Bar, $10,200; 10-f., 12-f., or 15-f. channel, Bolivar Channel to Morgans Point, $283,479, $651,562, or $1,260,062, **75**, 873; **76**, 77.

By Lt. Quinn, 1875, removal of obstructions in San Jacinto River, $6,000, **75**, 875.

By J. A. Hayward, 1877, 12-f. ship channel, 100 f., 200 f. base, three routes: 1st, $402,620; $744,779; 2d, $342,014, $660,653; 3d, $160,994, $434,879, **77**, 460, 463.

By H. C. Ripley, 1877, 12-f. channel, Red Fish Bar to Bolivar Channel, 100 f. wide, $146,856; 150 f. wide, $216,096; 200 f. wide, $285,331; **77**, 463.

**Legislation.**

Proviso attached to act of Mar. 3, 1879, relating to Bayou Ship Channel Co., **79**, 214.

Subsequent action relating thereto, **81**, 1334; **82**, 1457; **84**, 394.

**Operations.**[a]

**1872–73.** Completion of channel, 1,500 f. by 70 f. by 7 f., through Red Fish Bar, by Government dredge, **73**, 65, 635.

**1874–75.** Channel, 2,982 f. by 60 f. by 7.5 f. to 10 f., **75**, 79, 870.

**1875–76.** Removal of total of 104,920 c. y.; channel, 61,000 f. by 14½ f. on Red Fish Bar. Work on channel between mouth of San Jacinto River and Bolivar Channel in progress, **76**, 76, 585, 586.

**1878–79.** Dredging in channel between Red Fish Bar and Bolivar Channel, **79**, 917; 510,379 c. y. dredged from channel in Lower Galveston Bay, **80**, 1236.

**1881–82.** 160,440 c. y. dredged from channel, **82**, 1456.

**1882–83.** 801,789 c. y. dredged from channel, **83**, 202, 1075. Work done not permanent, **83**, 1078, 1080.

**1886–87.** Survey of channel; preparations for resumption of dredging, **87**, 1419, 1421.

**1887–88.** 200,000 c. y. dredged from ship channel, **88**, 1284.

**1888–89.** 1,618,220 c. y. dredged from ship channel, **89**, 1549.

**1889–90.** 19,829 c. y. dredged, **90**, 1798.

**1891–92.** Maintenance and repair of beacons and triangulation stations, **92**, 1539.

**1892–93.** West bank of canal revetted for 1,959 l. f., **93**, 1873.

**1893–94.** Beacons repaired, fence erected about Government reservation, 153,376 c. y. dredged, **94**, 1396, 1397.

**1894–95.** 299,332 c. y. dredged, **95**, 1867.

**1895–96.** 122,513 c. y. dredged and 10 beacons rebuilt, **96**, 1543.

**Physical characteristics.**

Description, **71**, 534, 536; **76**, 586; **77**, 459, 461; **93**, 1872.

Obstructions in San Jacinto River, **75**, 874, 875.

Current observations, **77**, 464, 465.

Table of tides, **75**, 874, 875.

Shoaling, **93**, 1875, **95**, 1807; **96**, 1543; **97**, 1803.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Adams, 1870, three routes: (1) channel, 150 f. by 12 f., through Galveston Bay and Buffalo Bayou to Houston; (2) channel, 150 f. by 6 f. at m. l. w. across the Red Fish and Clopper's bars; (3) channel, 100 f. by 6 f., across Red Fish and Clopper's bars. Each of the plans to include the removal of obstructions, shore protection by sheet piling between Harrisburg and Houston. Third plan recommended by Lt. Adams, **71**, 536.

By J. A. Hayward, ship channel through Galveston Bay: (1) 12-f. channel from San Jacinto River to Bolivar Channel; (2) San Jacinto River to Red Fish Bar and Bolivar Channel; (3) Morgans Point to Bolivar Channel, with retaining wall, **77**, 459, 461, 463.

By Lt. Quinn, 1875, removal of rebel obstructions, consisting of flats and scows in the San Jacinto River, **75**, 875.

**Private (private and corporate) work.**

Valuable improvements made below Harrisburg by the Houston Direct Navigation Co. The expenditures should be reimbursed and channel tolls established, **71**, 533, 535, 536; **71**, 461.

The contractor and private parties continued the work on channel, 1875, after the expenditure of appropriation; removed 4,832 c. y., **76**, 586.

[a] History of operations since 1873, **79**, 912.

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.—Continued.

### Part A.—Galveston Bay ship channel, Tex.—Continued.

Proviso attached to act of Mar. 3, 1879, requiring the Bayou Ship Channel Co. to surrender their rights before application of appropriation of 1880, **79**, 214.

Action relating thereto and subsequent compliance of the company, **81**, 1334, 1338; **82**, 1457.

**Projects.**[a] (See *Estimates* and *Plans*.)

By Lt. Adams, channel, 100 f. by 6 f., across Red-Fish and Clopper's bars, $62,805. Approved by Capt. Howell, increasing estimate to $125,000, **71**, 533, 535, 536. Revised by Capt. Howell to channel 150 f. by 10 f.; and, again, to channel 9 f. deep through Red-Fish Bar alone, **74**, 740; **75**, 79, 870, 872.

By J. A. Hayward, channel, 12 f. in depth, mouth of San Jacinto River to Bolivar Channel, **75**, 79. Recommended by Capt. Howell, changing the upper terminus to Morgan's Point, **75**, 873. Concurred in by the Chief of Engineers, **76**, 76; **77**, 456, 459, 588.

By Capt. Howell, 12-f. channel from Red-Fish Bar to Bolivar Channel, **77**, 466. Approved by Board of Engineers, **77**, 467.

By Capt. Howell, 1878, channel, 100 f. by 12 f., from Red-Fish Bar to Morgan's Point, **78**, 83, 607; **79**, 110.

In 1883 the Board of Engineers reported that the channel could not be made permanent at any reasonable cost, **83**, 1081.

Recommended by Chief of Engineers that available funds be reserved pending the action of Congress, **83**, 1082; **84**, 217.

By Maj. Miller, 1892, after acquisition by United States of the Morgan Cut and Canal, formerly owned by the Buffalo Bayou Ship Channel Co., for maintaining a channel at least 100 f. wide and 12 f. deep from Bolivar Channel to outer end of Morgan Cut and Canal, the channel to be suitably marked by beacons, **93**, 1872.

By Maj. Miller, 1893, for expending available funds to dredge at Red-Fish Bar and in Morgan Cut a channel having a depth of 9½ f. below m. l. tide, and width at bottom of about 100 f.; to revet about 1,900 l. f. of west bank of the Morgan Canal, and to slope both banks to prevent erosion, **93**, 1873.

**Surveys.**

By Lt. H. M. Adams, **71**, 66, 533, 534.

By Lt. H. M. Adams, to Dollar Point, **71**, 66.

By Lt. Quinn, examination of San Jacinto River, **75**, 874.

By J. A. Hayward and H. C. Ripley, **77**, 75, 458, 459, 462.

Resurvey of channel made, 1889, under direction of Maj. Ernst, **89**, 1549.

Survey along the line of the ship channel made in 1897. (See *Galveston, Tex., Channel from, to Houston.*)

MAPS. **90**, 1800; **91**, 1911.

### Part B.—Buffalo Bayou, Tex. (See *Galveston Bay ship-channel.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1881, | $25,000, | **81**, | 1343. |
| 1882, | 50,000, | **82**, | 1459. |
| 1884, | 25,000, | **84**, | 1306. |
| 1886, | 18,750, | **86**, | 1326. |
| 1888, | 25,000, | **88**, | 1288. |
| 1890, | 25,000, | **90**, | 1809. |
| 1892, | 25,000, | **92**, | 1551. |
| 1894, | 15,000, | **95**, | 1818. |
| 1896, | 20,000, | **96**, | 1549. |
| Total, | 228,750 | | |

**Commerce.**

Important, **81**, 1346; **84**, 1307; **93**, 1886; **96**, 1549.

Cotton shipments, **90**, 1808

**Contracts.**

**1881.** G. L. Long, dredging, 21 cents c. y.; removal of trees, $190 per mile, **82**, 1459.

**1882.** J. J. Atkinson, dredging, 26 cents per c. y.; removal of trees and stumps, and revetment of banks, **83**, 1084.

**1884.** R. Moore, dredging, 23 cents per c. y.; removal of snags, $2.70 each, **85**, 1458.

**1887.** J. J. Atkinson, dredging and removal of obstructions, **87**, 1424.

**1888.** J. J. Atkinson, dredging and rock removal, $24,192, **89**, 1561.

**1891.** J. J. Atkinson, dredging and removal of trees and logs, $21,110, **91**, 1927.

**1893.** L. Meggett, dredging, 31 cents per c. y.; removal of obstructions, 6¼ and 7½ cents per c. f., and $14.85 per hour ($25,000), **93**, 1888.

**1894.** R. Moore Dredging Co., dredging, 30 cents per c. y.; removal of obstructions, 5 and 6 cents per c. f., and $13.50 per hour ($9,840), **95**, 1818.

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[a] The project of 1871-77 proposed the formation of a dredged channel 100 f. wide at bottom and 12 f. deep at m. l. w. from the head of Bolivar to the U. S. Cut through Red-Fish Bar, thence to the cut through Morgan's Point. Estimate, $446,326.42. **78**, 608; **79**, 918; **80**, 1237; **87**, 1418. Improvement not considered permanent, **79**, 918; **83**, 1074.

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.—Continued.

### Part B.—Buffalo Bayou, Tex.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 150; **81**, 201, 204; **82**, 198; **83**, 203; **84**, 218; **85**, 227; **86**, 225; **87**, 190; **88**, 174; **89**, 205; **90**, 185; **91**, 234; **92**, 227; **93**, 256; **94**, 237; **95**, 265; **96**, 229; **97**, 296; **98**, 286; **99**, 340; **1900**, 386.

ENGINEERS IN CHARGE:

Maj. S. M. Mansfield, 1880–86. Reports, **81**, 1342, 1344; **82**, 1458; **83**, 1083; **84**, 1305; **85**, 1457; **86**, 1325.

Maj. O. H. Ernst, 1886–90. Reports, **87**, 1423; **88**, 1286; **89**, 1559.

Maj. C. J. Allen, 1890–92. Reports, **90**, 1807; **91**, 1924; **92**, 1548.

Maj. A. M. Miller, 1893–97. Reports, **93**, 1886; **94**, 1409; **95**, 1816; **96**, 1547; **97**, 1806.

Maj. J. B. Quinn, 1898. Report, **98**, 1510.

Capt. C. S. Riché, 1899–. Reports, **99**, 1977; **1900**, 2330.

ASSISTANTS:

B. F. Taylor. Reports, **81**, 1344; **84**, 1306.

R. B. Talfor. Reports, **88**, 1288; **89**, 1561; **91**, 1928; **92**, 1551; **93**, 1889; **94**, 1411; **96**, 1549.

**Operations.**

**1881–82.** 24,895 c. y. dredged and trees removed from $11\frac{2}{10}$ miles of river bank, **82**, 1459.

**1882–83.** 162,680 c. y. dredged, 971 trees removed, and 1,247,801 sq. f. of bank cleared, **83**, 1084.

**1883–84.** 64,943 c. y. dredged and 379 trees removed, **84**, 1305.

**1884–85.** 78,600 c. y. dredged and 277 snags removed, **85**, 1457.

**1885–86.** 13,500 c. y. dredged and 26 stumps removed, **86**, 1326.

**1887–88.** 56,677 c. y. dredged and 2,852 c. f. logs removed from the bayou, **88**, 1287.

**1888–89.** 48,104 c. y. dredged and 1,795 c. f. sunken logs removed, **89**, 1560.

**1889–90.** 6,651 c. y. dredged and 1,062 c. f. logs and stumps removed, **90**, 1808.

**1890–91.** 26,000 c. y. dredged; 2,900 c. y. material dug from the banks; 2,900 c. f. logs removed from the channel and 13,348 c. f. trees from the banks, **91**, 1925.

**1891–92.** Removing stumps and logs and excavating from projecting points, **92**, 1551.

**1892–93.** 23,358 c. y. dredged and and about 1,200 obstructions removed, **93**, 1887.

**1893–94.** 27,980 c. y. dredged and over 100 obstructions removed, **94**, 1410.

**1895–96.** 36,474 c. y. dredged, about 750 obstructions removed, and 20,500 c. f. trees felled, **96**, 1548.

**Physical characteristics.**

Description of bayou, **81**, 1345; **87**, 1423; **90**, 1807.

Shoaling, **96**, 1549.

**Plans.**

By Maj. Mansfield, 1880, for forming a channel between Simms and White Oak bayous, 150 f. wide and 12 f. deep; estimate, $1,125,341, **81**, 1344, 1346.

**Private (corporate) work.**

Charter of the Buffalo Bayou Ship-Canal Co., **87**, 1425.

**Projects.**

By Maj. Mansfield, 1880, channel 100 f. wide and 12 f. deep between Simms Bayou and mouth of White Oak Bayou at Houston; revetment of bank, removal of trees, and dredging; estimate, $385,299, **81**, 1343, 1344, 1346; **91**, 1925; **92**, 1550.

Permanent improvement not expected, **87**, 190.

By Maj. Miller, 1892, expending appropriation of that year in dredging bars to depth of 10 f. at m. l. w., in easing sharpness of points, and in removal of obstructions, **93**, 1887.

In 1896 Maj. Miller recommended combining this work with that on Galveston Bay Ship Channel, **96**, 1548.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 150; made under direction of Maj. Mansfield, 1880, **81**, 1344.

### Part C.—Galveston Ship Channel and Buffalo Bayou, Tex. (See *Galveston Bay* and *Buffalo Bayou Ship Channel.*)

**Appropriations.**

1899, $300,000, **99**, 1964.

**Commerce.**

Description of, **98**, 1519.

Large and important. The board of 1897 reported probably $600,000 annually would be saved in freight rates by an improved channel, **98**, 1519.

**Contracts.**

**1900.** C. Clarke & Co., dredging, 6.98 cents per c. y.; dike constructing, 11½ cents per l. f. ($342,330), **1900**, 2328.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **98**, 228; **99**, 340; **1900**, 386.

## GALVESTON SHIP CHANNEL AND BUFFALO BAYOU, TEX.—Continued.

### Part C.—Galveston ship channel and Buffalo Bayou, Tex.—Continued.

Board of Engineers:

Convened by S. O. No. 7, dated Feb. 12, 1897, at Houston, Tex., July 26, 1897, to make examination and report called for by act of Feb. 1, 1897. Report, **98**, 1515. (Col. H. M. Robert, Maj. A. M. Miller, and Capt. McC. Derby.)

Engineers in Charge:

Maj. J. B. Quinn, 1897–98. Report, **98**, 1515.

Capt. C. S. Riché, 1899–. Report, **99**, 1964; **1900**, 2327.

**Operations.**

Old beacons renovated, new ones constructed, and location of same in progress, **1900**, 2327.

**Physical characteristics.**

Description of route: 58¾ miles long, naturally divided into two parts; the first through the open waters of Galveston Bay and Morgan Canal, and the second through San Jacinto Bay and river of same name to Lynchburg, and thence up Buffalo Bayou to Houston, **98**, 1517.

**Projects.**

By Board of Engineers, 1897, 17½ f. channel, 80 f. wide, with side slopes about 1 on 2, from deep water in Galveston Harbor, Galveston Bay, and Morgans Cut (Division 1); for constructing pile and brush dike from Morgans Cut to Red Fish Bar, and for surveys, superintendence, and contingencies that might be necessary, $25,000 being reserved for administration, surveys, and maintenance above Division 1 (through San Jacinto Bay to Houston, Tex.); estimate, $4,000,000, and $100,000 annually for maintenance, **98**, 1518; **1900**, 2327.

Act of Feb. 20, 1900, repealed the items of appropriation in the act of March 3, 1899, relating to improvement of Galveston Ship Channel and Buffalo Bayou, Tex. The following amendment was substituted: *Provided*, That all sums heretofore appropriated and available for the work on Galveston Ship Channel and Buffalo Bayou are hereby made available for said [that of 1897] project: *Provided further*, That all of said sums of money not necessary for administration, surveys, and maintenance be used in improving Division No. 1 of said survey. **1900**, 387.

**Surveys.**

Act of Feb. 1, 1897, called for examination and survey, with estimate of cost, for obtaining a channel not less than 25 f. deep and 100 f. wide from jetty mouths at Galveston, through existing ship channel, and up Buffalo Bayou to Houston; and for harbor at the latter place of same depth, but 500 f. width. Made by board in same year (see *Projects*). **98**, 1515.

## GASCONADE RIVER, MO. (See *Missouri River*, *Part G.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $5,000, | **80**, | 1461. |
| 1881, | 10,000, | **81**, | 1660. |
| 1882, | 10,000, | **82**, | 1731. |
| 1884, | 5,000, | **84**, | 1540. |
| 1886, | 7,500, | **86**, | 1397. |
| 1888, | 5,000, | **88**, | 1448. |
| 1890, | 4,000, | **90**, | 1990. |
| 1892, | 4,000, | **92**, | 1740. |

Total, 50,500

**Commerce.**

Not unimportant, **73**, 480–482.

**Engineers.**

Chief of Engineers. Reports, **72**, 56; **73**, 56; **79**, 127; **80**, 168, 169; **81**, 229; **82**, 226; **83**, 233; **84**, 237; **85**, 254; **86**, 247; **87**, 214; **88**, 194; **89**, 229; **90**, 205; **91**, 261; **92**, 251; **93**, 283; **94**, 259.

Engineers in Charge:

Lt. Col. W. F. Raynolds, 1872–73; **72**, 56; **73**, 53.

Col. J. H. Simpson, 1873. Report, **73**, 479.

Maj. C. R. Suter, 1879–85. Reports, **79**, 127; **80**, 1461; **81**, 1660; **82**, 1731; **83**, 1337; **84**, 1540.

Maj. A. M. Miller, 1885–94. Reports, **85**, 1637, 1654; **86**, 1396; **87**, 1590; **88**, 1448; **89**, 1703; **90**, 1989; **91**, 2112; **92**, 1739; **93**, 2178; **94**, 1617.

Assistants:

J. D. McKown. Report, **73**, 480.

T. T. Johnston. Reports, **80**, 1462; **83**, 1338.

J. W. Beaman. Reports, **88**, 1449; **89**, 1704; **90**, 1990; **91**, 2113; **92**, 1740; **93**, 2180; **94**, 1619.

**Operations.**

**1880–81.** Removal of snags and similar obstructions begun, **81**, 1660.

**1881–82.** Removal of snags continued, **82**, 1731.

**1882–83.** Removal of snags completed throughout 78 miles of river, **83**, 1337.

**1884–85.** 194 snags removed; banks cleared; repairs to wing-dam, **85**, 1637.

## GASCONADE RIVER, MO.—Continued.

**1886–87.** 1,888 trees and snags removed, **87**, 1590.

**1887–88.** 943 l. f. of dam, or training wall, built by hired labor, **88**, 1448.

**1888–89.** 284 snags and stumps removed from the channel and 446 trees cut from the banks, improving 78 miles of river; work done by hired labor, **89**, 1703.

**1889–90.** 65 l. f. of bank revetment laid; 22 log cribs built; 522 l. f. of crib and stone dam built, and 150 snags removed from the channel; work done with hired labor, **90**, 1989.

**1890–91.** 276 c. y. stone quarried; repairs to plant, **91**, 2112.

**1891–92.** 419 snags removed from the channel; 2,153 trees cleared from the banks, **92**, 1741.

**1892–93.** About 400 snags and other obstructions removed; 3 new dams built and 2 old ones repaired, **93**, 2179.

**1893–94.** About 1,000 obstructions removed, **94**, 1618.

**Physical characteristics.**

Description, **73**, 480–482; **80**, 1462.

Fall of river bed, **73**, 480, 481; disappearance of water under the bed; remarkable "boiling spring," **73**, 481.

**Plans.**

Improvement with locks and dams not considered advisable, **73**, 480–482.

**Projects.**

By J. D. McKown, removing snags, rock, overhanging trees, and wing-dams; estimate, $22,978. Approved by Col. Simpson. **73**, 480–482.

By Maj. Suter, 1880, mouth to Vienna, 78 miles, removing snags and similiar obstructions; estimate, $50,000, **80**, 1466; **91**, 2112.

**Surveys.**

Survey by J. D. McKown, **73**, 56, 479, 480.

Ordered by act of March 3, 1879; made, 1880, under direction of Maj. Suter, **80**, 1461.

## GAULEY RIVER, W. VA.

**Appropriations.**

1888, $3,000, **88**, 224.
1890, 3,000, **90**, 2248.
1892, 3,000, **92**, 2068.
1894, 3,000, **94**, 1964.
1896, 3,000, **96**, 2263.

Total, 15,000

**Commerce.**

The first attempt since 1889 to drive logs through "The Roughs," made in 1898, 2,000,000 f. B. M., cut and put in the river to be rafted down to the mills, **99**, 2498.

**Engineers.**

Chief of Engineers.—Reports, **88**, 224, 226; **89**, 260; **90**, 234; **91**, 301; **92**, 288; **93**, 327; **94**, 300; **95**, 334; **96**, 291; **97**, 380; **98**, 366; **99**, 431; **1900**, 494.

Engineers in Charge:

Col. W. P. Craighill, 1886–89. Report, **88**, 1761.

Capt. T. Turtle, 1889–90. Report, **89**, 1959.

Col. W. P. Craighill, 1890–95. Reports, **90**, 2248; **91**, 2428; **92**, 2067; **93**, 2598; **94**, 1964.

Lt. Col. P. C. Hains, 1895–97. Reports, **95**, 2462; **96**, 2263.

Maj. J. F. Gregory, 1897. Report, **97**, 2564.

Maj. W. H. Bixby, 1898. Report, **98**, 2138.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2496; **1900**, 3340.

Assistants:

N. H. Hutton. Report, **88**, 1762.

W. P. Smith. Reports, **89**, 1959; **90**, 2249; **91**, 2429; **92**, 2068; **93**, 2599; **95**, 2462; **98**, 2139.

A. M. Scott. Reports, **98**, 2139; **99**, 2498; **1900**, 3341.

**Operations.**

**1888–89.** 52 c. y. rock blasted and removed, **89**, 1960.

**1890–91.** 212 c. y. solid and 2,070 c. y. loose rock removed from the channel, **91**, 2430.

**1891–92.** 3,184 c. y. rock removed and 6,980 l. f. of training wall built, **92**, 2067.

**1892–93.** 5,034 l. f. new walls built; nearly 5,000 c. y. loose rock and bowlders removed, **93**, 2601.

**1894–95.** 729 c. y. loose rock and 918 c. y. bowlders blasted and removed, **95**, 2463.

**Physical characteristics.**

Description of, **88**, 1761

**Projects.**

By Capt. Turtle, 1887, mouth to "The Roughs," 12 miles, removal of rock ledges and obstructions, giving a channel 20 f. wide and 2 f. deep at ordinary l. w.; estimate, $10,000, **88**, 224. At and above "The Roughs," rock removal and construction of training walls; estimate, $65,000. Total estimate, $75,000. **88**, 224; **89**, 1959; **92**, 2067.

By Capt. Hodges, 1899, for expending available funds to blast down large rocks on the shoals and to cut trees to facilitate the floating of logs over "The Roughs," **99**, 3340.

**Surveys.**

Examination ordered by act of August 5, 1886, made, 1887, under direction of Col. Craighill, **87**, 253; **88**, 1761.

Maps. **88**, 1762.

## GEDNEYS CHANNEL, NEW YORK HARBOR. (See *New York Harbor.*)

## GENESEE RIVER, N. Y. (See *Charlotte Harbor, N. Y.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 337.

ENGINEER IN CHARGE. Capt. C. F. Palfrey, 1888. Report, **89**, 2424.

**Surveys.**

Examination ordered by act of August 11, 1888, made, 1889, under direction of Capt. Palfrey (report unfavorable), **89**, 2424.

## GENEVA, OHIO. (See *Cowles Creek.*)

## GEORGE. (See *Lake George.*)

## GEORGES RIVER, ME. (See *East Thomaston Harbor, Me.; St. Georges River, Me.*)

**Appropriations.**

1896, $10,000, **96**, 560.
1899, 10,000, **99**, 1038.

Total, $20,000.

**Commerce.**

Small, **93**, 735.

**Contracts.**

**1897.** Hamilton & Sawyer, dredging, 14.7 cents per c. y., s. m. ($7,350), **97**, 786.

**1899.** Hamilton & Sawyer, dredging, 16½ cents per c. y., s. m. ($11,550), **99**, 1038.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 38; **95**, 39; **96**, 32; **97**, 35; **98**, 45; **99**, 53; **1900**, 57.

ENGINEERS IN CHARGE:

Lt. Col. P. C. Hains, 1892. Report, **93**, 734.

Lt. Col. D. P. Heap, 1895. Report, **95**, 590.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 559.

Maj. R. L. Hoxie, 1897–98. Reports, **97**, 785; **98**, 827.

Maj. S. W. Roessler, 1899–. Reports, **99**, 1038; **1900**, 1093.

ASSISTANT. A. C. Both. Report, **95**, 591.

**Operations.**

**1897–98.** About 60,000 c. y. dredged, **98**, 827.

**1899–1900.** 56,997 c. y. dredged, **1900**, 1094.

**Physical characteristics.**

Description of, **93**, 734.

**Projects.**

By Lt. Col. Heap, 1895, channel 16 f. deep, with width of from 90 to 220 f.; estimate, to include repairs to a beacon at Browns Point, $30,000, **95**, 590.

**Surveys.**

Examination ordered by act of July 13, 1892, made, 1892, by Lt. Col. Hains (report favorable to improving to Thomaston), **93**, 734.

Survey ordered by act of August 17, 1894, made, 1895, under direction of Lt. Col. Heap (see *Projects*), **95**, 591.

## GEORGETOWN AND WASHINGTON HARBORS, D. C. (See *Potomac River in vicinity of Washington, D. C.*)

## GEORGETOWN HARBOR. (See *Potomac River, Md. and Va.; Sampit River, S. C.; Sassafras River, Md.*)

## GEORGETOWN HARBOR, S. C.[a] (See *Sampit River, S. C.*)

**Appropriations.**

1836, $1,000 (survey), act July 4.
1852, 3,000 (survey), act Aug. 3.
1882, 7,000, **83**, 872.
1884, 5,000, **84**, 1052.
1886, 5,000, **86**, 1082.
1888, 7,500, **88**, 927.
1890, 8,000, **90**, 1166.
1892, 12,000, **92**, 1184.

Total, 48,500

**Commerce.**

Gain from 1880 to 1889, **89**, 1106; **90**, 1168.

In 1893 the approximate tonnage was 272,070 tons; apparently increasing, **93**, 1439.

**Contracts.**

**1884.** C. Gilbert, dredging, 12½ cents per c. y., **85**, 1115.

**1887.** C. Gilbert, dredging, 30 cents per c. y., **87**, 1076.

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[a] Survey.—Report June 10, 1854; estimate indefinite (H. Doc. No. 482, 55th Cong., 2d sess.).

## GEORGETOWN HARBOR, S. C.—Continued.

**1889.** P. S. Ross, dredging, 23 cents per c. y., **89**, 1104.

**1890.** P. S. Ross, dredging, 29 cents per c. y., **91**, 1409.

**1892.** P. S. Ross, dredging, 22.7 cents per c. y. ($8,000 to $10,500), **93**, 1438.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 168; **83**, 171; **84**, 177; **85**, 174; **86**, 172; **87**, 135; **88**, 129; **89**, 146; **90**, 132; **91**, 168; **92**, 168; **93**, 181; **94**, 166; **95**, 189; **99**, 247; **1900**, 280, 281.

ENGINEERS IN CHARGE:

Capt. C. B. Phillips, 1880–83. Report, **81**, 1036.

Capt. J. Mercur, 1883–84. Report, **83**, 872.

Capt. F. A. Hinman, 1884–85. Report, **84**, 1052.

Capt. W. H. Bixby, 1885–92. Reports, **85**, 1114; **86**, 1027; **87**, 1074; **88**, 925; **89**, 1102; **90**, 1165; **91**, 1408.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1183; **93**, 1437; **94**, 1057; **95**, 1347.

Maj. E. H. Ruffner, 1899. Report, **99**, 1526.

Capt. J. C. Sanford, 1900. Report, **1900**, 1850.

ASSISTANTS:

C. W. Forster. Report, **81**, 1037.

R. Whitford. Reports, **85**, 1116; **86**, 1028; **87**, 1076; **88**, 927; **89**, 1104; **90**, 1167; **91**, 1410; **92**, 1184.

C. Humphreys. Report, **94**, 1438.

**Operations.**

**1884–85.** 20,924 c. y. dredged; snags and stumps removed, **85**, 1115.

**1885–86.** 2,684 c. y. sand dredged; logs and stumps removed, **86**, 1027.

**1886–87.** 7,614 c. y. dredged from bar at mouth of Sampit River, **87**, 1075, 1076.

**1888–89.** 15,563 c. y. dredged from channel under contract; 130 stumps and logs removed, **89**, 1103.

**1891–92.** 13,448 c. y. dredged and 142 cypress stumps removed from the channel, **92**, 1184.

**1892–93.** 31,856 c. y. dredged, 44 stumps and 8 logs removed, and project completed, **93**, 1438.

**1893–94.** 40 logs and other obstruction removed, **94**, 1057.

**1894–95.** About 36 logs and stumps removed and 4 beacons erected, **95**, 1347.

**Projects.**

By Capt. Phillips, 1881, dredging channel 200 f. wide, with a depth of 12 f. through shoal across the mouth of Sampit River one-half mile from Georgetown. Estimated cost, $14,151.50, **81**, 1038; **86**, 1029; **87**, 1074.

In 1885 $12,000 had been appropriated and Capt. Bixby proposed the modification of the project so as to cover the removal of stumps not provided for in original project. Estimated cost, $30,000, **85**, 1117; **86**, 1030. Increased in 1887 to $42,000, **87**, 1074. Raised in 1889 to $44,500, **89**, 1103. Amount appropriated to June 30, 1889, $24,500; amount required for completion, $20,000, **89**, 1103.

**Physical characteristics.**

Description of, **81**, 1037.

Original condition of harbor, **88**, 925.

**Surveys.**

Ordered by act of June 14, 1880, made, 1881, under direction of Capt. Phillips, **81**, 1036.

Survey of the channel and wharves from the mouth of Sampit River to the head of the town limits for the establishment of harbor lines made, 1892, under the direction of Maj. Stanton, **93**, 1438.

MAPS:

**85**, 1114; **86**, 1028; **87**, 1076; **89**, 1104; **92**, Atlas, 41, 42; **93**, 1440.

## GEORGIA CANAL, ROME TO MACON.[a]

**Commerce.**

Requirements, **72**, 535.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **71**, 64; **72**, 60.

ENGINEER IN CHARGE. Maj. Walter McFarland. Report, **72**, 510, 512, 516, 518.

ASSISTANT. R. C. McCalla. Report, **72**, 526.

**Physical characteristics.**

General description, **72**, 526.

**Plans.**

By R. C. McCalla, 1872, canal, 70 f. wide at surface, 56 f. at bottom, and 5 f. depth of water, 211.2 miles in length $20.435,-684, **72**, 516, 526–535.

**Surveys.**

Under direction of Maj. McFarland, by R. C. McCalla, report, **72**, 510, 512, 516, 518, 526.

[a] Part of proposed line of water communication from the Mississippi River to the Atlantic.

## GEORGIANA RIVER, CAL.

**Commerce.**
Description of; estimated amount in 1894, 11,600 t. annually, and of sufficient importance to warrant a removal of obstructions from the stream, **95**, 3329.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **95**, 440.
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1895. Report, **95**, 3328.
ASSISTANT. Lt. G. D. Fitch. Report, **95**, 3329.

**Physical characteristics.**
Description of; branch of the Sacramento River connecting it with the Mokelumne River, about 12 miles long, and a width ranging from 120 to 250 f., and with an ample depth of 15 f., **95**, 3329.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made in that year under the direction of Maj. Heuer. (report favorable to removing obstructions), **95**, 3328.

## GLASGOW, MO. (See *Missouri River between mouth and Sioux City.*)

## GLEN COVE HARBOR, ME.

**Commerce.**
Unimportant, **95**, 577.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 38.
ENGINEER IN CHARGE. Lt. Col. D. P. Heap, 1895. Report, **95**, 577.

**Physical characteristics.**
Description of, **95**, 578.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made by Lt. Col. Hains, 1894 (report unfavorable), **95**, 587.

## GLEN COVE HARBOR, N. Y. (See *Hempstead Bay and Harbor, N. Y.*)

**Appropriations.**
1888, $20,000, **88**, 56.
1890, 15,000, **90**, 633.
1892, 10,000, **92**, 721.
1894, 10,000, **95**, 840.
1896, 8,000, **96**, 741.

Total, 63,000

**Commerce.**
Present and prospective, **87**, 646.

**Contracts.**
**1889.** Brown & Fleming, gneiss riprap, 83 cents per ton, **89**, 729.
**1890.** J. A. Bouker, breakwater extension, 80 cents per c. y. for stone, **91**, 822.
**1892.** Brown & Fleming, breakwater construction, stone, 69 cents per ton ($5,520), **93**, 980.
**1894.** J. A. Bouker, breakwater construction, stone, 65 cents per long ton ($9,000), **95**, 840.
**1896.** J. F. Quinn, extension and repair of breakwater, stone, 59 cents per long ton ($7,000), **97**, 1105.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **87**, 56; **88**, 56; **89**, 69; **90**, 61; **91**, 77; **92**, 82; **93**, 89; **94**, 79; **95**, 90, 94; **96**, 87; **97**, 122; **98**, 117; **99**, 132; **1900**, 150.
ENGINEERS IN CHARGE.
Lt. Col. D. C. Houston, 1886–92. Reports, **87**, 645; (Col.), **89**, 728; **90**, 662; **91**, 820; **92**, 720.
Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 978; **94**, 700; (Col.), **95**, 838, 877.
Maj. H. M. Adams, 1896–98. Reports, **96**, 740; **97**, 1103; **98**, 1007.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1225.
Maj. E. H. Ruffner, 1900. Report, **1900**, 1399.
ASSISTANT. J. C. Sanford. Report, **87**, 645.

**Operations.**
**1888–89.** 4,216 t. stone placed in 220 l. f. of breakwater, **89**, 728.
**1889–90.** 8,284 t. stone placed in 350 l. f. of breakwater, **90**, 663.
**1890–91.** 3,024 c. y. stone delivered in breakwater, **91**, 821.
**1891–92.** 13,220 c. y. riprap gneiss placed in breakwater extension, **92**, 721.
**1892–93.** 8,250 t. stone deposited in breakwater, **93**, 979.
**1893–94.** 3,300 t. stone deposited, **94**, 701.
**1894–95.** 12,983 t. stone deposited, **95**, 839.
**1896–97.** 11,845 t. stone deposited, **97**, 1104.

**Physical characteristics.**
Description of, **87**, 645; **89**, 728.
Hempstead Harbor the same as Glen Cove Harbor, **95**, 878.

**Projects.**
By Col. Houston, 1886, 2,500 l. f. of riprap breakwater extending from Mosquito Point in a westerly direction; esti-

## GLEN COVE HARBOR, N. Y.—Continued.

mate, $201,960, **87**, 646; **89**, 728; **92**, 720.

By Col. Robert, 1895, modifying the project so as to provide for a breakwater 2,000 f. long, extending westerly from the northwest corner of Glen Cove Dock, the top to be 5 f. wide and 3 f. above high water, with slopes of 1 on 1; estimate, from the beginning, $135,000, **95**, 839, 841.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. Houston, **87**, 645.

Survey of Hempstead Harbor (see *Physical characteristics*) ordered by act of Aug. 17, 1894, made by Lt. Col. Robert in that year (report unfavorable to further improvement), **95**, 877.

MAPS. **89**, 728.

## GLOUCESTER HARBOR, MASS.

**Appropriations.**

1823, $6,000, act, Mar. 3.
1872, 10,000, **72**, 92.
1886, 5,000, **87**, 504.
1888, 10,000, **88**, 444.
1890, 15,000, **90**, 492.
1892, 40,000, **92**, 568.
1894, 40,000, **95**, 611.
1896, 34,000, **96**, 597.
1899, 40,000, **99**, 1067.

Total, 200,000.

**Commerce.**

Important, **71**, 870, 871, 874, 875; **72**, 941, 942; **85**, 541; **87**, 503.

Vested interests of the harbor, **88**, 444.

Importance of the harbor, **90**, 491.

**Contracts.**

**1872.** With G. W. Townsend, rock excavation, **73**, 1083.

**1888.** Duncan & Mickerson, rock removal, $14.75 per c. y., **88**, 444.

**1889.** G. W. Townsend, blasting and removing rock, $20 per c. y., removal of loose overlying material, $15 per c. y., **89**, 566. Bay State Dredging Co., dredging, 30 cents per c. y., **89**, 566.

**1890.** Bay State Dredging Co., dredging, 22 cents per c. y., removal of bowlders weighing over 3 t., $8 each, **91**, 637.

**1892.** National Dredging Co., dredging, 23 cents per c. y., removal of bowlders over 3 t., $15 (173,913 c. y.), **93**, 753.

**1893.** Townsend & Johnson, ledge removal, $9.86 in situ per c. y. ($5,413.14), **94**, 541.

**1894.** Rockport Granite Co., stone, 87 cents per short t. (41,379 t.), **95**, 611.

**1896.** Rockport Granite Co., and Pigeon Hill Granite Co., and Cape Ann Granite Co., stone, 83 cents per short t. (34,000 t.), **97**, 836. H. M. Phillips, rock removal, $15.85 per c. y. ($1,664.25), **97**, 836.

**1899.** Rockport, Pigeon Hill, and Cape Ann Granite Cos., stone, 89 cents, $3.75, and $1.39 per short t.; mortar, $9.50 per c. y.; iron in place, 27.5 cents per pound ($40,765), **1900**, 1165.

**Defense.**

Land ceded to U. S. Government by selectmen of Gloucester for purposes of a fortification, **71**, 876.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 32, 78; **71**, 93; **72**, 92; **73**, 102; **74**, 111; **75**, 116; **76**, 42; **85**, 67; **88**, 25; **89**, 35; **90**, 30; **91**, 36; **92**, 43; **93**, 42, 52; **94**, 40; **95**, 43; **96**, 45; **97**, 49; **98**, 57; **99** 66; **1900**, 74.

ENGINEERS IN CHARGE.

Lt. Col. J. G. Foster, 1870–71. Reports, **70**, 467; **71**, 869.

Lt. Col. G. Thom, 1871–76. Reports, **72**, 941; **73**, 1083; **74**, ii, 311; **75**, ii, 402; **76**, 166.

Maj. C. W. Raymond, 1885. Reports, **85**, 534, 540, 541.

Lt. Col. G. L. Gillespie, 1886–89. Reports, **87**, 500, 505; **88**, 442.

Lt. Col. S. M. Mansfield, 1889–98. Reports, **89**, 564; **90**, 491; **91**, 635; **92**, 566; **93**, 751, 787; **94**, 539; **95**, 609; **96**, 596; **97**, 835; **98**, 856.

Col. C. R. Suter, 1899. **99**, 1066.

Maj. W. L. Fisk, 1900. **1900**, 1164.

ASSISTANT. H. F. Bothfeld. Reports, **71**, 873; **85**, 542; **87**, 506.

**Estimates.** (See *Projects.*)

By H. F. Bothfeld, breakwater, $494,148.65, **71**, 874, 876.

**Operations.**

**1872–73.** Rocks removed, **73**, 102, 1083.

**1888–89.** 70 c. y. loose rock and 100 c. y. ledge removed; 17,596 c. y. dredged, **89**, 565.

**1891–92.** 47,298 c. y. dredged, **92**, 568.

**1893–94.** 386 c. y. of rock removed, and the dredging called for by the project completed, **94**, 540.

**1894–95.** About 160 c. y. of rock removed, and 35,497 t. of stone placed in breakwater, **95**, 610.

**1895–96.** 17,701 t. stone placed in breakwater, **96**, 597.

## GLOUCESTER HARBOR, MASS.—Continued.

**1896–97.** 21,870 t. stone placed in breakwater, **97**, 835.

**1897–98.** 16,322 t. of stone placed in breakwater, and 105 c. y. of rock removed, **98**, 857.

**1899–1900.** 15,896 t. of stone placed in breakwater. **1900**, 1165.

**Physical characteristics.**

Presence of rocks and ledges in harbor, **71**, 870, 874, 875.

Locality described, **85**, 534, 542.

Description, Gloucester Harbor, **93**, 787; Vincent Cove, **93**, 789.

**Plans.** (See *Projects.*)

By H. F. Bothfeld, breakwater, 3,870 f. long, 50 to 100 f. wide at the base, 20 f. wide at the top, and from 11 to 35 f. high; the substructure to be of riprap, and the superstructure to be of cut-granite facings, with coping and concrete filling, **71**, 873.

By Maj. Raymond, 1885, removal of a part of Babson's Ledge in completion of the original project; estimate, $4,800, **85**, 541, 543.

By Maj. Raymond, 1885, formation of a harbor of refuge with two breakwaters, aggregate length of 7,250 f.; estimate, $1,359,000, **85**, 535; **87**, 501, 502.

By Lt. Col. Gillespie, removal of Babson's Ledge, based upon late surveys; dredging a channel 15 f. deep at low water, Harbor Cove to Pew's Wharf, also the deepening of Harbor Cove to 10 f.; estimate, $65,000; **87**, 503.

**Projects.** (See *Plans.*)

The project of 1871 proposed to clear the harbor of sunken rocks and to build a stone breakwater from Eastern Point to Round Rock Shoal; estimate, $10,606, **70**, 870, 875; **71**, 873; **87**, 500.

The appropriation of $10,000 of 1872 was expended upon the removal of rock, **73**, 1083; **87**, 501.

By Lt. Col. Gillespie, 1887, removal from the inner harbor of 101 c. y. of rock and of 216,000 c. y. material; also for breakwater recommended in the project of 1884, extending from Eastern Point to Round Rock Shoal; estimate, $817,000, **88**, 443.

By Lt. Col. Mansfield, 1892, for use of available funds to complete proposed dredging, **93**, 752.

By Lt. Col. Mansfield, 1894, for use of available funds to commence construction of substructure of breakwater at Eastern Point, **95**, 610.

By Lt. Col. Mansfield, 1896, for removal of some rocks in and about the harbor, **97**, 835.

**Surveys.**

By H. F. Bothfeld, 1870. Report, **71**, 873.

Ordered by act of July 5, 1884, made under direction of Maj. Raymond, **85**, 540; **87**, 502, 505.

Examination from Five Pound Island to river head ordered by act of July 13, 1892, made by Lt. Col. Mansfield, 1892; report favorable, **93**, 787.

Examination of Vincent Cove ordered by act of July 13, 1892, made by Lt. Col. Mansfield, 1892; report unfavorable, **93**, 788.

MAPS:

**87**, 504.

Of inner harbor, **87**, 506.

## GOLDEN GATE. (See *San Francisco, Cal.*)

## GOLDEN GATE AND STRAITS OF KARQUINES CHANNEL, CAL.

**Commerce.**

Great, **1900**, 4259.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **1900**, 634.

ENGINEER IN CHARGE. Lt. Col. W. H. Heuer, 1899–1900. Report, **1900**, 4259.

**Physical characteristics.**

Description of, **1900**, 4259.

**Projects.**

Maj. Heuer estimated, 1899, it would cost $381,000 to obtain improvement desired by act of 1899, and also $16,000 annually for maintenance, **1900**, 4262.

**Surveys.**

Examination and survey of Point Pinhole, Point Wilson, and Lone Tree Point, with a view to obtaining a channel 30 f. deep and 300 f. wide, ordered by act of Mar. 3, 1899. Report favorable, submitted, 1899, by Maj. Heuer. **1900**, 4258.

## GOOSE RAPIDS ON RED RIVER OF THE NORTH (Lock and dam). (See *Red River of the North, Dak. and Minn.*)

## GORDONS LANDING, LAKE CHAMPLAIN, VT. (Breakwater).

**Appropriations.**

1886, $18,750, **87**, 314.
1888, 10,000, **88**, 2096.
1890, 6,000, **90**, 2878.

Total, 34,750

**Contracts.**

**1888.** W. J. Daly, breakwater construction, **88**, 2096.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 314; **88**, 287; **89**, 340; **90**, 307; **91**, 385; **92**, 363.

ENGINEER IN CHARGE: Maj. M. B. Adams, 1886–92. Reports, **87**, 2400; **88**, 2095; **89**, 2445; **90**, 2877; **91**, 2930; **92**, 2606.

**Operations.**

**1887–88.** 4,711 c. y. rubblestone placed in breakwater, **88**, 2096.

**1888–89.** 3,570 c. y. rubblestone placed in breakwater, **89**, 2446.

**1889–90.** Breakwater construction continued, **90**, 2877.

**1890–91.** 3 cribs built and sunk in extension of breakwater, and reconstruction of old superstructure begun, **91**, 2931.

**Projects.**

By Maj. Adams, 1887, rubblestone breakwater extending from a point 250 f. south of landing to a point on the 18-f. curve 100 f. north of a line drawn from the dock to Cumberland Head; estimate, $38,158, **87**, 2400; **92**, 2607.

**Surveys.**

MAPS. **87**, 2400.

## GOSHEN CREEK, N. J.

**Appropriations.**

1892, $3,000, **93**, 1181.
1894, 3,000, **95**, 1074.
1896, 3,000, **96**, 934.
1899, 8,000, **99**, 1363.

Total, 17,000.

**Contracts.**

**1892.** F. C. Somers, dredging, 14.9 cents per c. y. ($2,011.50), **93**, 1181.

**1897.** F. C. Somers, dredging at 14 cents per c. y., pile dike construction at $4.99 per l. f. ($4,114), **97**, 1226.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 119; **93**, 128; **94**, 117; **95**, 131; **96**, 121; **97**, 153; **98**, 155; **99**, 180; **1900**, 204.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1890—. Reports, **91**, 1116; **93**, 1180; **94**, 859; **95**, 1073; **96**, 933; **97**, 1225; (Lt. Col.) **98**, 1102; **99**, 1362; **1900**, 1585.

**Operations.**

**1892-93.** 15,770 c. y. dredged, **93**, 1181.

**1896-97.** 600 l. f. of pile dike constructed, and 8,002 c. y., dipper measurement, **97**, 1225.

**1898-99.** 310 cords of brush, 150 poles, and 371 tons stone delivered for construction of new dike, **99**, 1363.

**1899-1900.** 118 cords of brush, and 1,301 tons stone placed for repair and construction of dikes, and 10,436 c. y. dredged, **1900**, 1586.

**Physical characteristics.**

Description of, **91**, 1116.

**Projects.**

By Maj. Raymond, 1891, channel below Goshen Landing to a low-water depth of 3 f. and width of 30 f., dredging a channel 3 f. deep and 50 f. wide through the bar at the mouth of the creek and out to the limit of the sand formation beyond the low-water shore line, and the protection of the dredged channel by a sheet-pile jetty on the south side of the channel extending about 600 f. outside of the low-water line of the bay; estimate, $12,000, **91**, 1119.

Maj. Raymond reported, 1897–98, the cost of completing the project should be increased $8,000 to provide for the extension of the dike, and for necessary dredging, **98**, 1102.

By Lt. Col. Raymond, 1899, for expenditure of available funds in dike construction and extension, and for dredging, **99**, 1363.

**Surveys.**

Survey ordered by act of September 19, 1890, made, 1891, under direction of Maj. Raymond, **91**, 1118.

Examination made by Maj. Raymond, 1897–98, **98**, 1102.

**GOVERNORS ISLAND.** (See *New York Harbor, N. Y.*)

**GOWANUS BAY, N. Y.** (See *Bay Ridge Channel; Buttermilk Channel; Gowanus Creek, N. Y.*)

**Appropriations.**

1881, $40,000, **81**, 635.
1882, 20,000, **82**, 661.
1883, 5,000, **84**, 708.
1886, 7,500, **86**, 725.
1888, 60,000, **88**, 617.
1890, [a]160,000, **90**, 731.
1892, [b]198,600, **92**, 823.
1894, 150,000, **95**, 947.

Total, 641,100.

**Commerce.**

Commercial statement from 1880 to 1884, **84**, 707.

Necessity for enlarged channels, **87**, 712, 714.

**Contracts.**

**1881.** J. W. Ambrose, dredging, 17 cents per c. y., **82**, 661.

**1883.** E. Brainard, dredging, 18 cents per c. y., **84**, 708.

**1884.** H. Du Bois's Sons, dredging, 19.9 cents per c. y., **85**, 673.

**1886.** E. Brainard, dredging, 32 cents per c. y., **87**, 711.

**1889.** J. A. Simmons, dredging, 18½ cents per c. y., **89**, 787.

**1891.** W. H. Beard, dredging, 21 cents per c. y., **91**, 917. W. H. Beard, dredging, 21 cents per c. y., **91**, 918.

**1893.** International Dredging Co., dredging, 13.7 cents per c. y. ($124,670), **93**, 1058. J. D. Leary, dredging, 13⅝ cents per c. y., **94**, 767.

**1894.** W. H. Beard Dredging Co., dredging, 15 cents per c. y. ($135,000), **95**, 948.

**Engineers.**

Chief of Engineers. Reports, **80**, 85; **81**, 101; **82**, 102; **83**, 97; **84**, 103; **85**, 93; **86**, 98; **87**, 61; **88**, 62; **89**, 78; **90**, 70; **91**, 89; **92**, 93; **93**, 101; **94**, 91; **95**, 103.

Engineers in Charge.

Col. J. Newton, 1880–84. Reports, **81**, 634, 635; **82**, 659; **83**, 544.

Capt. J. Mercur, 1884–86. Reports, **84**, 706; **85**, 672.

Lt. Col. W. McFarland, 1886–89. Reports, **86**, 722; **87**, 709; **88**, 613.

Lt. Col. G. L. Gillespie, 1889–95. Reports, **89**, 784; **90**, 727; **91**, 914; **92**, 817; **93**, 1053; **94**, 764; **95**, 943.

Assistant. R. H. Talcott. Report, **81**, 636.

**Legislation.**

Operations under appropriations of 1882 prevented by legal formalities for securing right of way, **83**, 544; **87**, 710.

**Operations.**

**1881–82.** 158,458 c. y. dredged, **82**, 659.

**1882–83.** 60,708 c. y. dredged, **83**, 544.

**1883–84.** 91,609 c. y. dredged, **84**, 706.

**1884–85.** 22,996 c. y. dredged, **85**, 673.

**1886–87.** 21,497 c. y. dredged from channel below Hamilton Street Bridge, **87**, 711.

**1888–89.** 38,938 c. y. dredged; two canal-boat wrecks removed, **89**, 787.

**1889–90.** 135,967 c. y. dredged, **90**, 730.

**1890–91.** 268,000 c. y. dredged, **91**, 917.

**1891–92.** 520,000 c. y. dredged from Red Hook, Gowanus Creek, and Bay Ridge channels, **92**, 820.

**1892–93.** 20,297 c. y. dredged, **93**, 1057.

**1893–94.** 852,137 c. y. dredged, **94**, 767, 768.

**1894–95.** 757,006 c. y. dredged, **95**, 946, 947.

**Physical characteristics.**

Description of, **88**, 613.

**Projects.**

By Col. Newton, 1881, dredging channel 200 f. wide and 18 f. deep at m. l. w. from the 18-f. contour outside the bay to Hamilton avenue drawbridge, the last 400 f. narrowing down to a width of 100 f.; estimate, $182,850, **81**, 636.

Revised project for dredging the natural channel from Hamilton avenue drawbridge to southwest corner of Erie Basin, and thence two channels, one running northerly along the west side of Erie Basin to deep water near Red Hook, the other running southerly along the wharves on the south side of the bay; estimate, $192,564, **81**, 672, 673; **87**, 712.

In 1887 Lt. Col. McFarland considered that the Red Hook, Bay Ridge, and Gowanus Creek channels should be widened to 400 f., with a l. w. depth of 21 f.; estimate, $403,500, **87**, 712.

By Lt. Col. Gillespie, 1889, for increasing the depth of the Gowanus Bay channels to 21 f. at m. l. w. and increasing their width to 400 f.; also removal of angle on south side of Gowanus Creek near its mouth; estimate, $600,000, **89**, 785, 786; **91**, 916.

By Lt. Col. Gillespie, 1892, for the expenditure of the appropriation of 1892 as follows: $58,000 on Red Hook Channel and $42,000 on Gowanus Creek Channel, **93**, 1056.

The existing project in 1894 amended in that year by act of Congress providing for a width of 800 f. and depth of 26 f.

[a] $100,000, Bay Ridge Channel.

[b] [illegible] Ridge Channel.

## GOWANUS BAY, N. Y.—Continued.

for Bay Ridge Channel, width of 400 f. and depth of 26 f. for Red Hook Channel, and width of 250 f. and depth of 21 f. for Gowanus Creek Channel; estimate, $483,300, **95**, 946.

In 1895 Lt. Col. Gillespie estimated it would cost either $2,391,814 or $2,929,114 to complete the work of improvement properly, **95**, 948.

**Surveys.**

Ordered by act of June 14, 1880; made, 1881, under direction of Col. Newton, **81**, 635.

MAPS. **81**, 636; **85**, 672.

## GOWANUS CREEK, N. Y.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 105.

ENGINEER IN CHARGE. Col. J. Newton. Report, **84**, 713.

**Plans.**

In 1882 a line of canal having taken the place of the creek, Col. Newton reported the creek unworthy of improvements, **84**, 714.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Col. Newton, **84**, 713.

## GOWANUS CREEK CHANNEL, N. Y. (See *Bay Ridge Channel, N. Y.; Gowanus Bay.*)

**Appropriations.**

1896, $25,000, **96**, 759.
1899, 25,000, **99**, 1275.

Total, 50,000

**Commerce.**

Description of; of the total freight carried in 1896, 2,164,654 tons, nine-tenths of this was carried in boats drawing less than 12 f., **97**, 1181.

**Contracts.**

**1897.** H. S. Beard, dredging, 24 c. per c. y., s. m.; bowlder removal, $12 per c. y. ($22,000), **97**, 1123, 1124.

**1899.** H. S. Beard, dredging, 14½ c. per c. y., s. m. ($23,000), **99**, 1276.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **96**, 92; **97**, 127, 141; **98**, 122; **99**, 146; **1900**, 165.

ENGINEERS IN CHARGE:

Maj. H. M. Adams, 1896–99. Reports, **96**, 758; **97**, 1122, 1180; **98**, 1020; **99**, 1274.

Maj. W. L. Marshall, 1900. Report, **1900**, 1469.

**Operations.**

**1896–97.** 75,417 c. y. dredged, **97**, 1123.

**1897–98.** 16,073 c. y. dredged, **98**, 1021.

**1899–1900.** 156,204 c. y. dredged, **1900**, 1470.

**Physical characteristics.**

Description of; originally a tidal inlet in the southern part of the city of Brooklyn, and emptying into Gowanus Bay, **97**, 1181.

The channel defined as extending from the junction of Bay Ridge and Red Hook channels opposite Henry street, Brooklyn, and Twenty-eighth street, Brooklyn, eastwardly to the foot of Percival street, the part east of Percival street being called Gowanus Canal, **96**, 758.

**Projects.**

About $75,000 had been spent on this channel up to 1892, (see *Gowanus Bay, N. Y.*), **1900**, 1471.

Under act of 1896 a project was adopted by Maj. Adams for dredging a channel 26 f. deep between the foot of Percival street, Brooklyn, and Red Hook channel, estimate, $70,000, **96**, 758.

In 1897 Maj. Adams estimated that to obtain a depth of 30 f. would cost $58,000 in addition to the estimated cost of the 26 f. channel in process of construction, **97**, 1181.

**Surveys.**

Harbor lines were slightly modified by act of June 3, 1896, **96**, 755.

Survey with a view to obtaining a channel 30 f. deep ordered by act of June 3, 1896, made by Maj. Adams, 1897 (see *Project*), **97**, 1180.

## GRAND BAYOU CUT-OFF, LA. (See *Red River.*)

## GRAND CAILLOU BAYOU, LA.

**Engineers.**

Chief of Engineers. Report, **80**, 146; **81**, 197; **82**, 193.

Engineer in Charge. Maj. A. Stickney. Report, **82**, 1410.

Assistant. H. S. Douglass. Report, **82**, 1411.

**Physical characteristics.**

Description of, **82**, 1411.

**Plans.**

By Maj. Stickney, 1882, channel 30 f. wide and 4 f. deep, junction of Bayou Pelton to Woodlawn plantation, 5 miles, and removing trees and other obstructions to junction of Bayou du Lac; estimate, $10,208, **82**, 1412.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 146; made under direction of Maj. Stickney, 1882, **82**, 1410.

## GRAND CALUMET RIVER, ILL. (See *Calumet River*.)

**Engineers.**

Chief of Engineers. Report, **89**, 293.

Engineer in Charge. Capt. W. L. Marshall, 1888–89. Report, **89**, 2158.

**Plans.**

By Capt. Marshall, 1889, for a 16 f. channel 200 f. wide, mouth to above the Forks; estimate, $1,000,000, **89**, 2158, 2159.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made 1889, under direction of Capt. Marshall, **89**, 2158.

## GRAND CALUMET RIVER, IND. (See *Calumet River*.)

**Engineers.**

Chief of Engineers. Report, **89**, 293.

Engineer in Charge. Capt. W. L. Marshall, 1888. Report, **89**, 2151.

Assistant. G. A. M. Liljencrantz. Report, **89**, 2153.

**Physical characteristics.**

Description of, **89**, 2153.

**Surveys.**

Survey ordered by act of Congress approved June 10, 1872, assigned to Maj. D. C. Houston, and made under his direction by W. J. Bryson, **72**, 36; **73**, 36. Report, **73**, 252, 253. Examination ordered by act of Aug. 11, 1888, made 1888 under direction of Capt. Marshall (report unfavorable), **89**, 2151.

## GRAND CHAIN. (See *Mississippi River*.)

## GRAND GULF, MISS. (Harbor).

**Engineers.**

Chief of Engineers. Reports, **80**, 158; **81**, 213.

Engineer in Charge. Maj. W. H. H. Benyaurd. Report, **81**, 1470.

Assistant. H. St. L. Coppée. Report, **81**, 1472.

**Plans.**

By Maj. Benyaurd, 1880, for dredging from Station C to Ferry at Big Black River, and thence to near gauge No. 3; estimate, $1,054,780, **81**, 1476, 1477.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction of Maj. Benyaurd (report unfavorable), **81**, 1470.

## GRAND HAVEN HARBOR, MICH.[a] (See *Grand River, Mich.*)

**Appropriations.**

| | | |
|---|---|---|
| 1852, | [b] $2,000.00, | **66**, iii, 34; **74**, 184. |
| 1866, | 65,000.00, | **66**, iii, 10, 34. |
| 1867, | 40,000.00, | **67**, 108; **74**, 187. |
| 1869, | 1,866.15 (allotted), | **69**, 22; **74**, 187. |
| 1869, | [c] 500.00, | **70**, 42. |
| 1870, | $10,000.00, | **70**, 42. |
| | [d] 1,885.00, | **70**, 40, 129. |
| 1871, | 6,000.00, | **71**, 40. |
| 1872, | 15,000.00, | **72**, 38. |
| 1873, | 75,000.00, | **73**, 38. |
| 1874, | 50,000.00, | **74**, 44. |

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[a] Survey.—Report, Dec. 15, 1849; estimate, $140,175.63. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] S. Ex. Doc. No. 42, 35th Cong., 1st sess., p. 92.

[c] Allotted from St. Josephs Harbor.

[d] Allotted from Frankfort Harbor, Mich.

## GRAND HAVEN HARBOR, MICH.—Continued.

**Appropriations**—Continued.
1876, $15,000.00, **76**, 102.
1878, 15,000.00, **78**, 122.
1879, 9,000.00, **79**, 164.
1880, 50,000.00, **80**, 2023.
1881, 50,000.00, **81**, 2222.
1882, 40,000.00, **82**, 2309.
1884, 50,000.00, **84**, 1986.
1886, 30,000.00, **86**, 1766.
1888, 25,000.00, **88**, 1912.
1890, 75,000.00, **90**, 2647.
1892, 90,000.00, **92**, 2340.
1894, 25,000.00, **95**, 2798.
1896, 20,000.00, **96**, 2695.
1899, 10,000.00, **99**, 2919.

Total, 771,251.15

**Commerce.**

Harbor of refuge, importance as, **67**, 109; **68**, 122; **75**, 253; **76**, ii, 495.

Importance, S. Ex. Doc. No. 42, 35th Cong., 1st sess., p. 89; **67**, 109.

Commercial importance of harbor, S. Ex. Doc. No. 42, 35th Cong., 1st sess., pp. 89, 90; S. Ex. Doc. No. 16, 34th Cong., 3d sess., pp. 207, 209, 243, 251, 383, 394; **68**, 122; **69**, 93; **70**, 138; **71**, 147; **76**, ii, 496; **79**, 164, 1619.

Lumber interests, **67**, 108; **69**, 93; **76**, ii, 496; **80**, 2021.

Losses to shipping occasioned by forming of bar across harbor mouth, **80**, 2019, 2020.

**Contracts.**

**1866.** H. Squier, materials and labor, **66**, iv, 100.

**1867.** J. H. Ledlie, materials and labor, **67**, 109. R. A. Conolly, materials and labor, **67**, 109.

**1868.** R. A. Conolly, contractor, overpaid by mistake; two claims made; one disallowed, **68**, 124. Alleged frauds of P. A. Woolley and others, **68**, 124.

**1869.** Squier & White, materials and labor, **69**, 93.

**1870.** T. S. White, materials and labor, **71**, 146. Pierce & Whaling, materials, **71**, 146. G. P. Adams & Bro., materials, **71**, 146.

**1872.** T. S. White, materials and labor, **73**, 272, 274.

**1873.** Squier & White, materials and labor, **73**, 273, 274.

**1874.** Squier & White, materials and labor, **75**, 254.

**1876.** James Caldwell,[a] materials and labor, **77**, 913.

**1878.** Henry S. Dale, materials and labor, **79**, 1618, 1621.

**1880.** H. S. Dale, pier extension, canceled, **80**, 2019. Squier & White, revetment construction, **81**, 2222.

**1881.** J. W. Dennis, pile foundation, **81**, 2222.

**1882.** Gillen & Kirby, pier construction and dredging, the latter at 40 cents per c. y., **83**, 1825.

**1884.** H. B. Herr, pier construction, **85**, 2080.

**1886.** T. W. Kirby, stone and edgings, **86**, 1767. Kelly, Maus & Co., iron, 2¼ cents per pound, **86**, 1767. Cutler & Savidge Lumber Co., timber, **86**, 1767.

**1889.** Hagen & English, stone, $7.90 per cord, **89**, 2186. T. W. Kirby, edgings, $1.20 per cord. Cutler & Savage Lumber Co., timber, $16.75 per 1,000 f. B. M., and plank, $13.50 per 1,000 f. B. M., **89**, 2186. Parkhurst & Wilkinson, drift bolts, 2.05 cents per pound, **89**, 2186. C. Berner, pier construction, $14,956, **89**, 2186.

**1890.** E. G. Crosby, timber crib construction, $23,418, **91**, 2695. E. G. Crosby, pine piles, 10 cents per l. f., and white pine timber, $17 per M f.; Gaylord & Wing, white pine plank, $15 per M f.; Parkhurst & Wilkinson, tie rods, 3 cents per pound; F. A. Hagen, stone, $2.24 per cord, **91**, 2695.

**1892.** Truman & Cooper, extension and repair of south pier, $2,047, **92**, 2345. Wisconsin Dredging & Dock Co., pier construction, aggregate of bid, $47,947.05, **93**, 2883.

**1893.** E. D. Weimer, pine timber, $25.25 per 1,000 f.; oak timber, $31 per 1,000 f, **93**, 2884. Parkhurst & Wilkinson, drift bolts, 2$\frac{1}{16}$ cents per pound, screw, 2⅞ cents per pound, **93**, 2884.

**1899.** Green & Wenzell, pier repairs (removing old work, timber, ironwork, stone), $8,185.66, **99**, 2919. Greens Dredging Co., dredging, **99**, 2920.

**1900.** Greens Dredging Co., dredging, **1900**, 3898.

**Documents.** (Not published in reports.) S. Doc. 16, 34th Cong., 3d sess.

**Engineers.**

Chief of Engineers. Reports, **66**, 5, iii, 10, 34, iv, 98; **67**, 24; **68**, 33; **69**, 32; **70**, 42; **71**, 40; **72**, 37; **73**, 38; **74**, 44; **75**, 48; **76**, 101, ii, 497; **77**, 107; **78**, 122; **79**, 164; **80**, 217, 2023; **81**, 294; **82**, 288; **83**, 296; **84**, 297; **85**, 319; **86**, 314; **87**, 281; **88**, 255; **89**, 300; **90**, 270; **91**, 340; **92**, 326; **93**, 372; **94**, 343; **95**, 381; **96**, 337; **97**, 427; **98**, 415; **99**, 494; **1900**, 557.

Engineers in Charge:

Maj. J. D. Graham, 1855–57. Report, S. Doc. 42, 35th Cong., 1st sess., p. 89.

Maj. J. B. Wheeler, 1866–69, **76**, ii, 497, 498. Reports, **66**, iv, 91, 99; **67**, 108; **68**, 122.

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[a] Contract extended, **78**, 1208.

## GRAND HAVEN HARBOR, MICH.—Continued.

Capt. F. U. Farquhar, 1869–72. Reports, **69**, 93; **70**, 137; **71**, 146; **72**, 181.

Capt. S. M. Mansfield, 1872–80. Reports, **72**, 189; **73**, 272; **74**, 184; **75**, 252; **76**, ii, 493; **77**, 912; **78**, 1208; **79**, 1618; (Maj.), **80**, 2019.

Maj. F. Harwood, 1880–82. Reports, **80**, 2019, 2024; **81**, 2219.

Maj. D. P. Heap, 1882–83. Report, **82**, 2307.

Capt. D. W. Lockwood, 1883–87. Reports, **83**, 1822; **84**, 1984; **85**, 2079; **86**, 1766; **87**, 2191.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1911.

Maj. W. Ludlow, 1889–93. Reports, **89**, 2184; **90**, 2646, 2648; **91**, 2692; **92**, 2340, 2346; **93**, 2879.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94**, 2208; **95**, 2795; **96**, 2693; **98**, 2509.

Capt. C. McD. Townsend, 1897. Report, **97**, 2918.

Capt. C. Harding, 1899–. Reports, **99**, 2917; **1900**, 3895.

ASSISTANTS:

J. R. Rowes, S. Doc. 20, 31st Cong., 1st sess.

Lt. A. Mackenzie. Reports, **66**, iv, 100; **67**, 108; **68**, 122.

J. F. Sanders, **68**, 124.

S. C. Mower, **79**, 1618. Reports, **75**, 253; **78**, 1209.

J. Macfie. Report, **79**, 1621.

F. W. Lehnartz. Report, **1900**, 3896.

**Estimates.** (See *Plans* and *Projects.*)

By Assistant Rowes, 1849, sheath piling, $21,950, S. Ex. Doc. 42, 35th Cong., 1st sess., p. 91.

By Maj. Graham, 1857, extension of piers to 12 f. of water, dredging and revetment, $160,185.60, S. Ex. Doc. 42, 35th Cong., 1st sess., pp. 92, 95, 175; **66**, iv, 99.

By Maj. Wheeler, 1866, repairs to railroad pier, sheet piling, and extension of south pier, $105,111.21, **66**, iv, 99, 100; **74**, 184.

By Lt. Mackenzie, 1866, completion, $352,770.47, **66**, iv, 101; **76**, ii, 494.

North pier extension, 1867, $200,000, **67**, 108; **68**, 123; **69**, 32, 93; **70**, 138; **71**, 40, 147; **72**, 38; **74**, 184; **76**, ii, 494.

Revised by Maj. Wheeler, 1867, completion, $200,111.21, **68**, 33.

By Capt. Mansfield, 1872, completion, $233,300, **72**, 190; **74**, 185; **76**, ii, 495.

Extension of north pier and pile revetment, 1875, $51,000, **75**, 254; **76**, ii, 495.

Completion of existing project, 1879, $20,148.96, **79**, 164, 1619.

**Operations.**[a]

**1866–67.** South side, 192 l. f. crib pier and 500 l. f. pile revetment built (repairs to old work), **67**, 24, 108; **74**, 184; **76**, ii, 498.

**1867–68.** South side, 100 l. f. crib pier, 1,943 l. f. pile revetment, and 192 l. f. superstructure built (repairs to old work), **68**, 33, 123, 126; **74**, 184; **76**, ii, 498.

**1868–69.** South side, 100 l. f. crib pier built (repairs to old work), **69**, 32, 93; **74**, 184; **76**, ii, 498.

**1869–70.** South side, 32 l. f. crib pier built (repairs to old work), **70**, 42, 137; **74**, 184; **76**, ii, 499.

**1870–71.** Repairs to old work, **71**, 40, 146; **74**, 185; **76**, ii, 499.

**1871–72.** Repairs to old work, **72**, 37, 181, 189; **74**, 185; **76**, ii, 499.

**1872–73.** South side, 700 l. f. pile revetment built (repairs to old work), **73**, 38, 272; **76**, ii, 499.

**1873–74.** North side, 1,506 l. f. pile revetment built; 45,488 c. y. dredged, **74**, 185; **76**, ii, 499.

**1874–75.** North side, 300 l. f. crib pier and 600 l. f. pile revetment built.

South side, 500 l. f. pile revetment built; 13,530 c. y. dredged. **75**, 48, 252; **76**, ii, 499.

**1875–76.** North side, 300 l. f. superstructure built (work unfinished at date of last annual report completed), **76**, 101, ii, 493.

**1876–77.** Damages repaired; pierheads riprapped, **77**, 107, 912.

**1877–78.** North side, 150 l. f. crib pier and 150 l. f. superstructure built (cribs riprapped; repairs), **78**, 122, 1208.

**1878–79.** North side, 150 l. f. crib pier built (repairs; willows planted), **79**, 164, 1618, 1620.

**1879–80.** Channel through bar at harbor mouth redredged; superstructure on north pier extension completed, **80**, 2019.

**1880–81.** Work commenced upon pile and slab revetment and south pier extension; extensive repairs to piers and revetments by day labor; wreck of schooner *Catchpole* removed; 5,910 l. f. catch-sand fence built, **81**, 2220, 2221.

**1881–82.** 1,633 l. f. pile revetment completed and reenforced by anchor piers; pile foundation for three cribs driven and cribs placed; 6,470 l. f. catch-sand fence built; portions of north and south revetments refilled by hired labor, **82**, 2307, 2308.

**1882–83.** Three cribs placed in extension of south pier, riprap placed along channel face, and sheet piling along south face of same; 100 l. f. of crib work, with superstructure placed in extension of south pier; repairs, by day labor, to pile-pier and north and south revetment; 16 oak-timber aprons placed between piles and cuts; 1,960 l. f. catch-sand fence built, **83**, 1822, 1823, 1824.

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[a] Operations suspended since 1852, **66**, 5. During the month of June, 1866, 309 l. f. of the railroad pile pier burned, **66**, iv, 100; **76**, ii, 498.

Damage to the north pier by a colliding vessel in 1875, **76**, ii, 493, 494. Dredging with a steam wrecking tug, **76**, ii, 493. The channel 400 f. wide, and available for any class of lake vessels, **76**, ii, 499; **77**, 107.

Histories of the operations, **74**, 184; **76**, ii, 496; **79**, 1620.

**1883–84.** 700 l. f. superstructure on south pier rebuilt, **84**, 1985.

**1884–85.** 710 l. f. south pier and two outer cribs refilled and redecked; also 802 l. f. revetment repaired, by hired labor, **85**, 2079.

**1885–86.** South pier extended by 200 l. f. crib work; breaches in pier head and revetment repaired, **86**, 1766.

**1886–87.** Completion of new superstructure to north pier; repairs to piers; progress on cribs for south pier extension, **87**, 2191.

**1887–88.** South pier extended 52 feet and north pier 150 f. under contract; repairs to south pier by hired labor, **88**, 1912.

**1888–89.** Extensive repairs to south pier revetment; 100 l. f. crib work built, **89**, 2184.

**1889–90.** North pier extended 150 f.; 2,388 l. f. of south pier revetment repaired; 600 l. f. sand fence built, **90**, 2647.

**1890–91.** 6,000 c. y. dredged; construction of crib work for pier extension begun; repairs to plant, **91**, 2694.

**1891–92.** Construction of crib in extension of south pier; sunken end of south pier rebuilt, and repairs made to timber and filling of north and south piers, **92**, 2342.

**1892–93.** Repairs made to south revetment, **93**, 2880; and extension of north and south piers in progress, **93**, 2881. Repairs made to Government dredging plant, **93**, 2881.

**1893–94.** Pier extension in progress, and repairs made, **94**, 2209.

**1894–95.** Pier extension completed, and general repairs made, **95**, 2796.

**1895–96.** South pier repaired, **96**, 2694.

**1896–97.** Repairs were made to south pier and storehouse, and 8,320 c. y. dredged, **97**, 2919.

**1897–98.** 40,942 c. y. dredged, and piers repaired, **98**, 2509.

**1898–99.** Minor repairs made to works, **99**, 2917.

**1899–1900.** Repairs of works, **1900**, 3896.

**Physical characteristics.**

General characteristics of Grand River, **76**, ii, 496.

Shore accretion rapid **66**, iv, 99; **74**, 186.

Beneficial effects of the north pier in maintaining a suitable depth of harbor channel, **74**, 186.

Bar across entrance to harbor usually forms in the fall, **74**, 185; **75**, 253; **76**, ii, 493; **78**, 122, 1209; **79**, 164, 1618.

Description of, **89**, 2184, 2185.

Memoranda of soundings, 1844–1866. Advance of shore line. **76**, ii, 496, 500.

The zero of the water gauge at the harbor was raised in 1894 0.28 feet to make it conform to the new plane of reference established for the harbors of Lakes Michigan and Huron, **94**, 2209.

Gauge readings, **96**, 2695, **97**, 2919, **99**, 2917, **1900**, 3897.

Shoal formation helped by sand blown in from adjoining dunes, **99**, 494.

Channel depths, **99**, 2917.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. A. Mackenzie, 1866, extension of north pier from a point 50 feet north of Maj. Graham's proposed pier, **66**, iv, 101; **67**, 108; **76**, ii, 494, 496.

By Asst. Mower, 1875, pile revetment, **75**, 253.

Extending north pier to 18 feet of water, 1878, and breakwater northward connected with pier head, **78**, 1209.

By Maj. Ludlow, 1890, extension of north bank revetment; repairing piers and extending same 200 and 300 feet, respectively; estimate, $74,200, **90**, 2651.

**Private (corporate) work.**

Bridge pier built by the Detroit & Milwaukee R. R. Co. on the south side of entrance, and with a direction 11 degrees more westerly than proposed by Maj. Graham, **66**, iv, 99; **76**, ii, 496, 498. Pile revetment, **66**, iv, 100.

Dredging by steamboat company, 1877, **78**, 122, 1209.

**Projects.** (See *Estimates* and *Plans.*)

By J. R. Rowes, 1849, sheath piling within river, approved by Board of Engineers, S. Doc. No. 42, 35th Cong., 1st sess., pp. 89, 91.

By Maj. Graham, 1857, two parallel crib piers 400 f. apart to 12 f. of water; sheath piling on south side of river; dredging to 12 f., S. Doc. No. 42, 35th Cong., 1st sess., pp. 91, 95, 175; **66**, iv, 99; **74**, 184; **76**, ii, 496. Appropriation of 1866 based on this plan, and should be applied in accordance therewith, unless modifications be necessitated by the work of the railroad company, **66**, iv, 99.

By Maj. Wheeler, 1866, revised in 1867, two parallel crib-work piers, 2,208 and 608 f. long, respectively, to afford a channel of entrance of navigable width and not less than 18 f. depth; estimate, $352,770.47, **66**, iv, 100; **76**, ii, 494; **80**, 217, 2033.

By Maj. Wheeler, 1867, north pier extension to 12 f. water, 200 f. channel, **67**, 24; **68**, 33; **69**, 32, 93; **72**, 38. Recom-

**GRAND HAVEN HARBOR, MICH.**—Continued.

mendation renewed, **70**, 138; **71**, 147; **74**, 184.

By Maj. Mansfield, 1875, extension of north pier; pile revetment and riprap, **75**, 49, 254. Recommendation renewed, **76**, ii, 494. Recommendation as to pile revetment renewed, **77**, 913.

Résumé of plans and projects, 1866–76, **76**, ii, 494.

After an aggregate appropriation since 1866 of $301,866.15, Maj. Harwood proposed, in 1880, the extension of piers to 18-f. water, beach protection, and repairs to existing works; estimate, $365,600, **80**, 2024.

**Surveys.**

Capt. Williams, 1844, **76**, ii, 496.

Col. Abert, 1849, **76**, ii, 496.

Maj. Graham, 1856, S. Ex. Doc. No. 42, 34th Cong., 1st sess., **76**, ii, 496.

Maj. Raynolds, 1865, **66**, iv, 99; **67**, 108.

Capt. Farquhar, 1869, **76**, ii, 498.

Capt. Farquhar, 1870, **76**, ii, 498.

Maj. Mansfield, **74**, 186; **76**, ii, 499.

Resurvey made in 1882, **82**, 2308.

Survey of bar at head of piers, 1884, **84**, 1984.

MAPS. **82**, 2310; **84**, 1984; **90**, 2650.

**GRAND LAKE, LA.** (See *Teche Bayou, La.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **83**, 212.

ENGINEER IN CHARGE, Maj. A. Stickney. Report, **83**, 1131.

ASSISTANT, H. C. Collins. Report, **83**, 1131.

**Physical characteristics.**

Grand Lake Bayou described, **83**, 1132.

**Plans.**

No improvement should be attempted until the route for entering the upper end of the lake be decided on, **83**, 1131.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 146; made under direction of Maj. Stickney, 1883 (see *Plans*), **83**, 1131.

**GRAND MARAIS, MICH. (Harbor of refuge).**

**Appropriations.**

1880, $10,000, **80**, 1902.
1881, 20,000, **81**, 2038.
1882, 40,000, **82**, 2117.
1884, 35,000, **84**, 1833.
1886, 26,250, **86**, 1649.
1888, 50,000, **88**, 1834.
1890, 50,000, **90**, 2305,
1892, 30,000, **92**, 2147.
1894, 20,000, **95**, 2578.
1896, 24,000, **96**, 2388.
1899, 25,000, **99**, 2721.

Total, 330,250

**Commerce.**

Improvement to afford a harbor of refuge between White-Fish Point and Grand Island Harbor, 90 miles, **73**, 229, 230. One of great cost unwarrantable, **71**, 130.

Necessity for harbor of refuge, **81**, 2043.

The importance of the place increasing, **93**, 2689; **94**, 2038; **95**, 2577; **96**, 2387; **97**, 2641; **98**, 2286.

Railroad connections made with the harbor, **94**, 2038; **95**, 2577; **96**, 2387.

In 1897 807 vessels entered and departed, with a total tonnage of 142,536 tons, **98**, 2286; 1,910 tons, 1897; 116,050 tons, 1898 (in 1892 310 vessels entered and departed; 1899, 864), **1900**, 3611.

**Contracts.**

**1882.** C. S. Barker, labor and material for pier construction and for dredging, 25 cents per c. y., **83**, 1636.

**1884.** J. H. Gillett, superstructure and pier extension, **85**, 1974.

**1886.** C. Southerland, pier extension, **87**, 1999.

**1888.** M. H. Fitzpatrick, dredging, 19½ cents per c. y., **89**, 2025.

**1889.** Powell & Mitchell, superstructure construction, $24,928, **89**, 2025.

**1890.** H. Steele, repairs to pier work, $1,500; C. S. Barker, dredging, 17 cents per c. y., **91**, 2511.

**1892.** Powell & Mitchell, pier extension (mattresses, stone, etc.), $34,680.50, **93**, 2691.

**1895.** W. H. Holden, pile dike construction, piles, 10¾ cents per l. f.; timber, including ironwork, etc., $28 per 1,000 B. M., **95**, 2578. Contractor failed after completing a large part of the work, **96**, 2387.

**1896.** G. Taylor, building pile dike, $4,733.16. Failed, **96**, 2389. F. L. McDonald, same work, $5,761.88. Failed, **96**, 2399; **97**, 2640.

**1897.** A. & D. Sang, pier extension; mattress and stone foundation work, $49.98 per l. f.; stone for extra riprapping, $8 per cord in place, **97**, 2642.

## GRAND MARAIS, MICH.—Continued.

**1899.** W. C. Davidson, pier repairs. Some informal contracts. **99**, 2721.

**1900.** Powell & Mitchell, pier repairs, **1900**, 3612.

**Engineers.**

CHIEF OF ENGINEERS. Report, **71**, 37; **80**, 203; **81**, 273, 2053; **82**, 267; **83**, 276; **84**, 275; **85**, 298; **86**, 292; **87**, 258; **88**, 235; **89**, 273; **90**, 246; **91**, 316; **92**, 301; **93**, 343; **94**, 314; **95**, 351; **96**, 307; **97**, 392; **98**, 384; **99**, 455; **1900**, 520.

BOARD OF ENGINEERS. Convened at Marquette, Mich., July 18, 1881, by S. O. No. 14, to report upon a plan for a harbor of refuge near Grand Marais, Mich. Report, **81**, 2050. (Lt. Col. Comstock and Majs. Weitzel and Robert.)

ENGINEERS IN CHARGE:

Maj D. C. Houston. Report, **71**, 129, 130.

Lt. Col. H. M. Robert, 1880–83. Reports, **80**, 1902; **81**, 2038; **82**, 2117.

Capt. F. A. Hinman, 1883–84. Report, **83**, 1635.

Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1831; **85**, 1973.

Capt. C. E. L. B. Davis, 1886–89. Reports, **86**, 1646; **87**, 1999; (Maj.) **88**, 1832.

Maj. J. B. Quinn, 1889–91. Reports, **89**, 2023; **90**, 2303.

Capt. W. L. Fisk, 1891–92. Reports, **91**, 2509; **92**, 2145.

Maj. C. B. Sears, 1893—. Reports, **93**, 2689; **94**, 2037; **95**, 2576, **96**, 2386; **97**, 2640; **98**, 2285; **99**, 2719; **1900**, 3610.

ASSISTANT. L. Y. Schermerhorn. Reports, **81**, 2041, 2049.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. D. C. Houston: (1) piers to 18 f. of water and dredging of channel, $481,525, **71**, 37, 139; (2) modification of first two parallel piers and dredging, $291,930, **71**, 37, 130; (3) new channel and piers, $167,707.04, **71**, 37, 131.

**Operations.**

**1882–83.** 26 cribs built and 5 sunk; 19,029 c. y. dredged; construction of inspector's house completed, **83**, 1635.

**1883–84.** 9 cribs sunk in extension of west pier; construction of east pier begun by sinking 600 l. f. of crib work; entire work riprapped and decked; 13,075 c. y. dredged; breach through sand spit closed with brush and stone, **84**, 1831.

**1884–85.** 500 l. f. superstructure completed and west pier extended 50 f., **85**, 1973.

**1885–86.** West pier extended 250 l. f. and east pier 150 f.; 100 l. f. superstructure on west pier completed; 200 l. f. pile pier constructed by hired labor, **86**, 1647.

**1886–87.** Preparations for extension of west pier; 200 l. f. of west pier repaired; total amount of work accomplished, **87**, 1999, 2000.

**1887–88.** West crib pier extended 200 f., by sinking 4 cribs, **88**, 1833.

**1889–90.** 75,392 c. y. dredged, **90**, 2303.

**1890–91.** Repairs to pier work, and dredging, **91**, 2509.

**1891–92.** Channel 175 f. wide with a least depth of 17 f. dredged between the piers, **92**, 2146.

**1892–94.** East pier extended 300 l. f., **93**, 2690; **94**, 2037.

**1895–96.** About 4,000 l. f. of dike built, **96**, 2387.

**1896–97.** About 1,000 l. f. of dike built, **97**, 2640, 2641.

**1897–98.** About 300 l. f. of dike built and 250 l. f. of west pier extended, **98**, 2286.

**1900.** Pier repairs, and extension of east pier 200 f. in progress, **1900**, 3611.

**Physical characteristics.**

Variation of position of channel, **71**, 132.

Northwesterly winds the most prevalent, **71**, 132.

Description of, **71**, 129, 132; **93**, 2689; **94**, 2037.

The harbor slowly filling up with sand rolled in by the waves through the interval between the east pier and the eastern shore, **95**, 2577.

Bar formation, **96**, 2386; **97**, 2640.

Severe storms and ice formation damaging works constructed, **96**, 2387; **97**, 2640; **98**, 2286.

Pile dike completed in 1897 being gradually strengthened by sand accumulations, **1900**, 3611.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Houston: (1) two converging piers to 18 f. of water at the present entrance; dredging of channel, **71**, 37, 139; (2) modification of first two parallel piers 600 f. apart, location and dredging similar to first, **71**, 37, 130; (3) to open a channel westward of present entrance and to protect it by 2 parallel piers 300 f. apart, **71**, 131; (4) single pier, **71**, 130.

By Lt. Col. Robert, 1881: (1) artificial entrance, by cutting through the west spit near its western extremity, estimates $425,535, $502,425, $508,887, $511,445; (2) improvement of natural entrance; estimates, $561,506, $625,526, $603,020, $667,040, $595,034, $659,054, $661,980, $726,000, **81**, 2045, 2046, 2047, 2048.

**Private work.**

Channel dredged in 1884, deepened by private enterprise, **84**, 1831.

## GRAND MARAIS, MICH.—Continued.

**Projects.** (See *Estimates* and *Plans.*)

By Board of Engineers, 1881, forming a harbor of refuge at Grand Marais, Mich., by providing access to the bay through two parallel piers, 1,550 and 1,900 f. in length, respectively, with a dredged channel between them of 500 f. width and 20 f. depth at its lake end, and 300 f. width and 18 f. depth at its harbor end; estimate, $450,000, **81**, 2053; **87**, 1999; **91**, 2510.

By Maj. Sears, amending the existing project, to provide for a close-pile dike across the interval between the east pier and the eastern shore, **95**, 2577.

By Maj. Sears, 1899, for expending appropriation of 1899 in extending east pier, and in extensive repairing of old piers, **99**, 2720.

**Surveys.**

Examination ordered by act of March 3, 1871, made by Maj. Houston. Agreement of examinations with result of Lake Survey. **71**, 37, 129, 131.

Made, 1880, under direction of Col. Robert, **81**, 2039.

Minor surveys, **93**, 2689; **94**, 2037; **95**, 2577.

MAPS. **81**, 2040; **88**, 1834; **89**, 2024; **90**, 2304.

## GRAND MARAIS HARBOR, MINN.

**Appropriations.**

1879, $10,000, **79**, 150.
1880, 10,000, **80**, 1883.
1881, 20,000, **81**, 2031.
1882, 20,000, **82**, 2107.
1884, 10,000, **83**, 1625.
1886, 10,000, **86**, 1638.
1888, 15,000, **88**, 1815.
1890, 22,350, **91**, 2284.
1892, 10,000, **92**, 2122.
1894, 3,000, **95**, 2528.
1896, 3,000, **96**, 2335.
1899, 30,000, **99**, 2606.

Total, 163,350

**Commerce.**

Object of improvement to make a harbor of refuge, **75**, 184.

Importance of the locality as a harbor of refuge, **88**, 1814; **90**, 2282; **98**, 2218.

In 1893 the commerce was small, but at that time and in subsequent years the place was considered as a probable future shipping point for the large deposits of minerals in the back country, **93**, 2651; **98**, 2218.

In 1895 the total tonnage was 913 t., valued at $91,300, **96**, 2334.

**Contracts.**

**1879.** Williams & Upham, dredging, 28 cents per c. y., **80**, 1883.

**1881.** C. M. Wilson, breakwater construction, **80**, 2032.

**1882.** Williams & Upham, dredging, 30 cents per c. y., **83**, 1625. C. P. Macdougall, breakwater construction, **83**, 1626.

**1884.** Williams & Upham, dredging, 25 cents per c. y., **85**, 1950.

**1886.** Williams & Upham, dredging, 24¾ cents per c. y., **87**, 1956.

**1888.** Williams, Upham & Co., dredging, 24 cents per c. y., **89**, 1997.

**1890.** Williams, Daugherty & Upham, dredging, 20 cents per c. y., **91**, 2485.

**1892.** Williams, Daugherty & Upham, dredging 39,000 c. y., at 23 cents per c. y., **93**, 2653.

**1895.** Same firm, dredging, 20 cents per c. y., **95**, 2529.

**1897.** R. Smith, dredging, 17½ cents per c. y., **97**, 2587.

**1900.** Butler-Ryan Co., breakwater construction (embankment, cribs, stone filling, etc.), $28,982.60, **1900**, 3549.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 40; **79**, 150; **80**, 201; **81**, 270; **82**, 265; **83**, 274; **84**, 273; **85**, 295; **86**, 289; **87**, 255; **88**, 232; **89**, 267; **90**, 241; **91**, 310; **92**, 296; **93**, 336; **94**, 308; **95**, 343; **96**, 300; **97**, 385; **98**, 378; **99**, 448; **1900**, 513.

ENGINEERS IN CHARGE.

Maj. F. U. Farquhar, 1874–75. Report, **75**, 184.

Capt. C. J. Allen, 1879–86. Reports, **79**, 1475; (Maj.) **80**, 1882; **81**, 2029; **82**, 2106; **83**, 1624; **84**, 1822; **85**, 1949; **86**, 1637.

Capt. J. B. Quinn, 1886–91. Reports, **87**, 1954; (Maj.) **88**, 1814; **89**, 1996; **90**, 2282.

Capt. W. L. Fisk, 1891–92. Reports, **91**, 2484; **92**, 2121.

Maj. C. B. Sears, 1893–. Reports, **93**, 2651; **94**, 2009; **95**, 2528; **96**, 2333; **97**, 2585; **98**, 2217; **99**, 2605; **1900**, 3547.

**Operations.**

**1879–80.** 19,199 c. y. dredged, **80**, 1883.

**1880–81.** 16,666 c. y. dredged, **81**, 2030.

**1881–82.** Mayhew Point breakwater built, **82**, 2107.

**1882–83.** Shore connection and bulkhead crib nearly finished, **83**, 1624.

**1883–84.** Work on breakwater continued; 16,667 c. y. dredged, **84**, 1822.

**1884–85.** 31,625 c. y. dredged; repairs and filling to breakwater, **85**, 1949.

## GRAND MARAIS HARBOR, MINN.—Continued.

**1886–87.** Dredging resumed, **87,** 1956.

**1887–88.** Dredging in anchorage area continued, **88,** 1814.

**1888–89.** 14,572 c. y. dredged, **89,** 1996.

**1889–90.** 47,927 c. y. dredged, **90,** 2282.

**1890–91.** Repairs to breakwater, **91,** 2484.

**1891–92.** 70,851 c. y. dredged; repairs to breakwater, **92,** 2122.

**1893–94.** About 39,300 c. y. dredged, **94,** 2010.

**1895–96.** About 15,000 c. y. dredged, **96,** 2335.

**1896–97.** About 16,000 c. y. dredged, **97,** 2586.

**1899–1900.** Breakwater construction under way, **1900,** 3548.

**Physical characteristics.**

Description of; **75,** 184; **86,** 1637, The only harbor of refuge on the north shore of Lake Superior between Agate Bay and the international boundary line; **93,** 2652; **98,** 2217.

**Projects.**

By Maj. Farquhar, 1875, for dredging, within and bounded by Mayhews Point and the inner shore line, and construction of timber and stone breakwater to narrow the entrance and afford shelter for vessels; estimate $139,669.40, **75,** 184; **79,** 150; **80,** 1882, 1883; **86,** 290.

In 1887, Capt. Quinn proposed an extension of the dredged area and of the breakwater, **87,** 1954.

From 1887 to 1888 operations were conducted under Maj. Quinn's project of 1887, for an extension of the dredged area and the breakwater, estimate (including cost of original project) $254,444, **87,** 1954; **88,** 1814.

In 1889 Maj. Farquhar's project of 1875 was substituted, **75,** 184; **79,** 150; **80,** 1882, 1883; **86,** 290; **89,** 1996; **92,** 2122.

By Capt. Fisk, 1892, for expending the appropriation of 1892 ($10,000), in increasing the 16-f. area by dredging, **93,** 2652.

Maj. Sears, 1899, proposed applying appropriation of 1899 to construction of 350 f. of breakwater from westerly point under the existing project, **99,** 2606.

**Surveys.**

Under direction of Maj. Farquhar, **75,** 40, 184.

MAPS. **81,** 2032; **85,** 1950; **87,** 1954; **90,** 2282; **92,** Atlas, 101.

## GRAND PORTAGE AND WANS-WAU-GOISING BAY, MINN., Harbor of refuge.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81,** 247; **82,** 266.

ENGINEER IN CHARGE. Capt. C. J. Allen. Report, **82,** 2110.

**Physical characteristics.**

Locality described, **82,** 2110.

**Projects.**

In 1882 Capt. Allen estimated that a harbor of refuge at Grand Portage Bay would cost $111,677, and at Wans-wau-goising Bay $91,807, **85,** 2111.

**Surveys.**

Examination ordered by act of March 3, 1881 made, under direction of Capt. Allen (report unfavorable), **85,** 2110.

## GRAND RIVER (below Grand Rapids), MICH. (See *Grand Haven Harbor, Mich.; Plaquemine Bayou, La.*

**Appropriations.**

1881, $10,000, **81,** 2225.
1882, 15,000, **82,** 2312.
1884, 25,000, **84,** 1987.
1896, 50,000, **97,** 2922.
1899, 75,000, **99,** 2927.

Total, 175,000

**Contracts.**

**1882.** Squier & White, dredging, $6 per hour, **83,** 1826.

**1885.** R. Finch, dredging, 25 cents per c. y., **85,** 2082.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80,** 221; **81,** 294, 300; **82,** 289; **83,** 296; **84,** 298; **85,** 320; **86,** 314; **87,** 282, 286; **89,** 306; **91,** 345; **97,** 428; **98,** 416; **99,** 495; **1900,** 558.

BOARD OF ENGINEERS. Convened at New York City to examine and report upon project for improvement of Grand River. Report, **90,** 2618. (Cols. Abbot, Comstock, and Houston, and Lt. Col. Gillespie.)

## GRAND RIVER, MICH.—Continued.

Engineers in Charge:

Maj. F. Harwood, 1880–82. Reports, **81**, 2224, 2225.

Maj. D. P. Heap, 1882–84. Reports, **82**, 2311; **83**, 1825.

Capt. D. W. Lockwood, 1884–87. Reports, **84**, 1986; **85**, 2081; **86**, 1767; **87**, 2193, 2206.

Lt. Col. S. M. Mansfield, 1888. Report, **89**, 2206.

Maj. W. Ludlow, 1890. Report, **90**, 2676.

Capt. C. McD. Townsend, 1897. Report, **97**, 2921.

Lt. Col. G. J. Lydecker, 1898. Report, **98**, 2511.

Capt. C. Harding, 1899–. Reports, **99**, 2920; **1900**, 3899.

Assistant. G. W. Bunker. Reports, **99**, 2922; **1900**, 3902.

**Operations.**

**1881–82.** 7,267 c. y. dredged; two lighters built, **82**, 2311.

**1882–83.** 6,172 c. y. bowlders and 1,035 c. y. clay dredged, **83**, 1826.

**1883–84.** 18,029 c. y. dredged, **84**, 1987.

**1884–85.** 14,112 c. y. dredged, **85**, 2081.

**1885–86.** 60,176 c. y. sand, gravel, and clay, and 1,707 c. y. bowlders removed; cleaning the channel to a point 8 miles below mouth of Ganoes Canal at Grand Rapids, **86**, 1767.

**1886–87.** 6,158 c. y. dredged from vicinity of Haires Bar, **87**, 2194.

**1896–97.** 14,035 c. y. dredged, **97**, 2921.

**1897–98.** 147,170 c. y. dredged, **98**, 2511.

**1898–99.** Plant repaired and modified; 61,882 c. y. dredged; experimental contraction works built (drawings), **99**, 2921.

**1899–1900.** 88,170 c. y. dredged; 12,622 f. training walls constructed (drawings and photographs), **1900**, 3899.

**Physical characteristics.**

Description of, **98**, 2511.

Soundings of several bars before and after dredging, 1899, **99**, 2926.

**Projects.**

By Maj. Harwood, 1881, excavation of channel 100 f. wide and 4 f. deep at low water from Grand Rapids to deep water; estimate, $25,000, **81**, 2224. Increased by Maj. Heap, in 1882, to $35,000, **82**, 2311, 2312.

In 1896 Congress adopted a project for the improvement of the river by dredging a channel 100 f. wide at bottom and 10 f. deep from Grand Haven to Grand Rapids; estimate, $670,500, **97**, 2921.

Contraction works, experiments with, details of cost, construction, etc. (drawings and photographs), **99**, 2921, 2924; **1900**, 3900.

**Surveys.**

Ordered by act of June 14, 1880, made, 1881, under direction of Maj. Harwood, **81**, 2225.

Special surveys to cover localities embracing shoals, **85**, 2081.

Examination ordered by act of Aug. 5, 1886; made, under direction of Capt. Lockwood (report unfavorable), **87**, 2206.

Examinations from Grand Rapids to Lake Michigan ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Mansfield (report unfavorable), **89**, 2206.

Survey below Grand Rapids, act Sept. 19, 1890, under direction of Maj. Ludlow, **92**, 2372.

From 1896–98 such survey work as was thought necessary to preserve previous surveys was made by Lt. Col. Lydecker and Capt. Townsend, **98**, 2512.

Drawings and photographs. (See *Operations, 1899, 1900.*)

## GRAND RIVER, MO. (See *Brunswick, Mo.*)

**Commerce.**

Local, **89**, 1711.

**Engineers.**

Chief of Engineers. Report, **89**, 230.

Engineer in Charge. Maj. A. M. Miller, 1888. Report, **89**, 1709.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Maj. Miller, (report unfavorable) **89**, 1709.

## GRAND RIVER, OHIO.

**Engineers.**

Chief of Engineers. Reports, **91**, 373; **92**, 352.

Engineer in Charge. Maj. L. C. Overman, 1890. Reports, **92**, 2511, 2513.

**Physical characteristics.**

Description of, **92**, 2511.

**Plans.**

By Maj. Overman, 1891, for a channel 160 f. wide, 18, f. deep, and 7,310 f. long. Estimate, $39,000, **92**, 2514.

**Surveys.**

Survey made, 1891, under direction of Maj. Overman, **92**, 2513.

## GRAND RIVER HARBOR, OHIO. (See *Fairport Harbor, Ohio.*)

### GRAND TRAVERSE BAY, MICH. (Torch Lake near Eastport, Mich.)

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 286.

ENGINEER IN CHARGE. Capt. D. W. Lockwood, 1887. Report, **87**, 2210.

**Physical characteristics.**

Description of, **87**, 2211.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Lockwood (report unfavorable—"local"—"too costly"), **87**, 2210.

Grants Pass, Ala. (See *Dauphin Island.*)

### GRASS RIVER, MASSENA, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1882 | $3,000.00, | **83**, 1956. |
| 1890 | 6,000.00, | **90**, 2875. |
| 1894 | .30, | act, Aug. 23. |
| Total, | 9,000.30 | |

**Contracts.**

1888. W. J. Daly, dredging, $8 per hour, **89**, 2442.

1890. Daly Bros., dredging, **91**, 2927.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 233; **81**, 320; **83**, 323; **84**, 327; **85**, 353; **86**, 347; **87**, 313; **88**, 286; **89**, 338; **90**, 306; **91**, 384.

ENGINEERS IN CHARGE:

Maj. W. McFarland, 1880–83. Report, **81**, 2457.

Lt. Col. H. M. Robert, 1883–85. Reports, **83**, 1956; **84**, 2154.

Maj. M. B. Adams, 1885–91. Reports, **85**, 2296; **86**, 1898; **87**, 2396; **88**, 2092; **89**, 2442; **90**, 2874; **91**, 2926.

ASSISTANT. F. T. Hampton. Report, **81**, 2458.

**Operations.**

1888–89. 1,670 c. y. dredged, **89**, 2442.

1890–91. 5,165 c. y. dredged, **19**, 2927.

**Projects.**

By Maj. McFarland, 1881, for improving river mouth to Haskells Wharf by dredging channel 4 f. deep at low water, estimate, $12,000, **81**, 2458.

Increased, 1885, $7,000, **85**, 2297.

Increased, 1886, $1,600, **86**, 1899; **87**, 2396.

**Surveys.**

Ordered by act of June 14, 1880, made, 1881, under direction of Maj. McFarland, **81**, 2457.

### GRAVESEND BAY, N. Y.

**Commerce.**

Limited, **95**, 1006

**Engineers.**

CHIEF OF ENGINEERS. Report, **95**, 121.

ENGINEER IN CHARGE. Lt. Col. G. L. Gillespie, 1895. Report, **95**, 1005.

**Physical characteristics.**

Description of; place used chiefly as an anchorage for small craft during storms coming from the north round by east to the south, **95**, 1005.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made in 1894 by Lt. Col. Gillespie (report unfavorable), **95**, 1005.

### GRAYS HARBOR AND BAR ENTRANCE, WASH. (See *Grays Harbor* and *Chehalis River, Wash.*)

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $20,000, | **96**, 3334. |
| 1897, | 350,000, | **97**, 3436. |
| 1899, | 285,000, | **99**, 3262. |
| 1900, | 50,000, | **1900**, 4470. |
| Total, | 705,000. | |

**Contracts.**

**1897.** Hall & Kern Contract Co., jetty construction (piles, 11 cents per l. f.; lumber, $11 per M f.; steel rails, $40; iron work, 4 cents per pound; brush, $1.20 per c. y.; stone, $1.10 per t.), $769,870, **98**, 3061.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 332; **82**, 324; **95**, 459; **96**, 407; **97**, 509; **98**, 512; **99**, 600; **1900**, 678.

ENGINEERS IN CHARGE:

Capt. C. F. Powell, 1881–82. Report, **82**, 2722.

Capt. T. W. Symons, 1895. Report, **95**, 3517.

Capt. H. Taylor, 1896—. Reports, **96**, 3333; **97**, 3436; **98**, 3059; **99**, 3261; **1900**, 4468.

ASSISTANTS:

R. Q. Habersham. Report, **2723**.

## GRAYS HARBOR AND BAR ENTRANCE, WASH.—Continued.

J. M. Clapp. Report, **98**, 3063; **99**, 3263; **1900**, 4471.

**Operations.**

**1897–98.** Jetty construction begun, **98**, 3060.

**1898–99.** Jetty trestle completed to 5,152 f. outside the high-water line; foundation built to 4,320 f.; enrockment completed to above high-water level for 3,520 f. (maps), **99**, 3261.

**1899–1900.** Jetty trestle advanced 2,584 f.; foundation completed for 3,336 f.; enrockment completed to level of ordinary high water for additional distance of 3,680 f. (maps), (photographs), **1900**, 4468.

**Physical characteristics.**

Description of, **82**, 2723; **95**, 3517; **98**, 3063.

The entrance to the harbor from the Pacific Ocean is about 45 miles north of the Columbia River. The harbor is about 17 miles long and about 14 miles broad from north to south. A few of the tributaries entering the harbor are the Satsop, Chehalis, Wynooche rivers, **95**, 3517. Through the harbor throat is a deep channel, and between this and the open sea is a bar convex to the sea and connected with sand spits on the two sides of the harbor throat. The channels across this bar in 1895 were variable and shifting, **96**, 3333.

Littoral current, description of, **95**, 3520.

Table showing differences between Grays Harbor and other harbors of the United States where jetties had been or were being constructed in 1895, **95**, 3531.

Improved condition of the bar, 1899, **99**, 3265; **1900**, 4470.

Tides and currents, **99**, 3265.

**Projects.**

In 1895 Capt. Symons estimated it would cost $2,363,309 to construct two jetties for the improvement of the harbor, **95**, 3533.

By Capt. Symons, 1895, for a single jetty of rubblestone built above high-tide level to extend out to sea from a point on the south side of the harbor throat for about 3½ miles, to concentrate the ebb and flood waters upon the bar to obtain a depth of 24 f. across the bar, at an estimated cost of $1,000,000, **96**, 3333.

**Surveys.**

Examination ordered by act of Mar. 3, 1881, made under direction of Capt. Powell (report favorable), **82**, 2722.

List of surveys made of the harbor, **95**, 3520.

Survey of the harbor, its bar and entrance with a view to improvement of the channels, ordered by act of Aug. 17, 1894, made, 1895, by Capt. Symons (see *Projects*), **95**, 3517.

Survey of the bar, made by direction of Capt. Taylor, 1898, **98**, 3060.

Minor surveys, **98**, 3060; **1900**, 4470, 4475.

MAPS. **95**, 3532; **98**, 3064; **99**, 3266.

## GRAYS HARBOR AND CHEHALIS RIVER, WASH. (See *Grays Harbor and Bar Entrance, Wash.*)

**Appropriations.**

1892, $50,000, **93**, 3408.
1895, 25,000, **95**, 3405.

Total, 75,000

**Contracts.**

**1892.** J. E. Howard, dike construction: piles, 8 cents per l. f.; lumber, $10 per M f.; bolts, 18 cents each; spikes and wire, 3 and 2.9 cents per pound; brush, $2.45 per cord; stone, 59 cents per s. t.; sand bags, 8 cents each; edgings, slabs, etc., $2 per cord ($44,086.50), **93**, 3409.

**1894.** Dickinson & Co., dike construction: piles, 8½ cents per l. f.; lumber, $11 per M f.; bolts, 18 cents each; spikes and wire, 3 cents per pound; brush, $2.49 per cord; stone, 62 cents per t.; edgings, etc., $2 per cord ($13,213.10), **95**, 3406.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 411; **93**, 442; **94**, 410; **95**, 452; **96**, 408.

ENGINEERS IN CHARGE.

Capt. T. W. Symons, 1890–95. Reports, **91**, 3297; **93**, 3408; **94**, 2597; **95**, 3405.

Capt. H. Taylor, 1896. Report, **96**, 3334.

ASSISTANTS.

R. A. Habersham. Report, **91**, 3298.

A. J. McMillan. Report, **91**, 3302.

J. M. Clapp. Reports, **93**, 3411; **94**, 2599; **95**, 3408; **96**, 3337.

**Operations.**

**1892–93.** 7,500 l. f. dike built, **93**, 3410.

**1893–94.** About 10,000 l. f. dike built, **94**, 2598.

**1894–95.** About 15,000 l. f. dike built, **95**, 3411.

**1895–96.** Repairs made to dikes, **96**, 3335.

**Physical characteristics.**

Description, bar and harbor, **91**, 3298.

The Chehalis River is the principal tributary of Grays Harbor. In 1893, on

## GRAYS HARBOR AND CHEHALIS RIVER, WASH.—Continued.

account of the division of the waters of the harbor into several channels, troublesome shoals existed at the head of the bay. **93**, 3408.

**Projects.** (See *Plans.*)

By Capt. Symons, 1891, removal of shoals from the river to a depth of 16 f. at half tide, by dredging and closing side sloughs and channels, for building dikes to close a south channel leaving a passageway 1,000 f. wide and about 8 f. deep, and to wholly close a middle channel to compel more of the ebb and flood waters to flow through a north channel and scour away existing bars; estimate, $150,000, **93**, 3408.

**Surveys.**

Survey, harbor and bar, ordered by act of Sept. 19, 1890; made, 1890, under direction of Capt. Symons (report unfavorable), **91**, 3300.

Survey made, 1894, by Capt. Symons, **94**, 2598.

MAPS. **91**, 3302; **94**, 2602.

## GRAYS RIVER, WASH.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 421.

ENGINEER IN CHARGE. Maj. T. H. Handbury, 1890. Report **91**, 3385.

**Physical characteristics.**

Description of, **91**, 3386.

**Plans.**

By Maj. Handbury, 1891, for removal of obstructions, snags, logs, etc., at a cost of $2,500, **91**, 3387.

**Surveys.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Handbury, **91**, 3386.

## GREAT BAY, N. H. (See *Piscataqua River, N. H. and Me.*)

## GREAT BAY, N. J. (See *Cape May to Great Bay; Little Egg Harbor Bay, N. J.*)

## GREAT BREWSTER ISLAND. (See *Boston Harbor.*)

## GREAT CACAPON RIVER, W. VA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 124.

ENGINEER IN CHARGE. Lt. Col. P. C. Hains, 1888. Report, **89**, 995.

**Physical characteristics.**

Description of, **89**, 995.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Hains (report unfavorable), **89**, 995.

## GREAT CHAZY RIVER, N. Y.

**Appropriation.**

| | | | |
|---|---|---|---|
| 1890, | $10,000, | **91**, | 2929. |
| 1892, | 5,000, | **92**, | 2606. |
| 1894, | 3,000, | **95**, | 3234. |
| Total, | 18,000 | | |

**Contracts.**

**1892.** L. Whitney, dredging, 34 cents per c. y. ($7,140), **93**, 3194.

**1894.** Lynch & Hannan, dredging, 45 cents per c. y. ($2,475), **95**, 3234.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 344; **91**, 385; **92**, 363; **93**, 416; **94**, 390; **95**, 426.

ENGINEERS IN CHARGE.

Maj. M. B. Adams, 1888–92. Reports, **89**, 2464; **91**, 2929; **92**, 2605.

Capt. S. S. Leach, 1893–95. Reports, **93**, 3194; **94**, 2493; **95**, 3234.

ASSISTANT. F. M. Barstow. Report, **89**, 2464.

**Operations.**

**1890–91.** Channel excavation under contract begun, **91**, 2929.

**1891–92.** 26,338 c. y. dredged, **92**, 2606.

**1893–94.** Dredging of 20,000 c. y. in progress, **94**, 2494.

**Physical characteristics.**

Description of, **89**, 2466.

**Plans.** (See *Projects.*)

By Maj. Adams, 1889, dredged channel 6 f. deep and 75 f. wide, 6-f. curve in Lake Champlain to Champlain Village; estimate, $34,000, **89**, 2466.

**Projects.** (See *Plans.*)

By Maj. Adams, 1891, channel with a

**GREAT CHAZY RIVER, N. Y.**—Continued.

least depth of 5 f. and a least width of 40 f., 5-f. curve in Lake Champlain to Champlain Village; estimate, $18,000, **91**, 2929; **92**, 2605.

**Surveys.**

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Adams, **89**, 2466.

**GREAT EGG HARBOR BAY, N. J.** (See *Barnegat Bay.*)

**GREAT FALLS.** (See *Missouri River; Potomac River, Md. and Va.*)

**GREAT KANAWHA RIVER, W. VA.** (See also *James River; James River and Kanawha Canal; Transportation routes to seaboard, central route, third subdivision.*)

**Appropriations.**

1873, [a]$25,000.00, **73**, 59, 505; **76**, 91, ii, 154; **77**, 297.
1874, [a]25,000.00, **74**, 66, 485; **76**, 91, ii, 154; **77**, 297.
1875, 300,000.00, **75**, 89, ii, 87; **76**, 91, ii, 154; **77**, 297, 676.
1876, 270,000.00, **76**, 91, ii, 154; **77**, 61, 297, 676.
1878, 222,000.00, **78**, 68, 469.
1879, 150,000.00, **79**, 80, 550.
1880, 200,000.00, **80**, 683.
1881, 200,000.00, **81**, 911.
1882, 200,000.00, **82**, 920.
1884, 200,000.00, **84**, 928.
1886, 187,500.00, **86**, 1590.
1888, 350,000.00, **88**, 1750.
64,749.45, **88**, 2825.
1890, 300,000.00, **90**, 2238.
1892, 225,000.00, **92**, 2045.
1893, 500,000.00, **93**, 2578.
1895, 580,700.00, **95**, 2448.
1897, 273,000.00, **97**, 2568.

Total, 4,272,949.45

**Commerce.**

Importance of improvement, **73**, 508, 835; **75**, ii, 90, 95; **77**, 304; **79**, 548; as part of line of water communication between Ohio River and tide water, **71**, 625, 627, 629, 644, 646; **74**, ii, 91, 102, 114, 123.

Requirements of coal trade, **73**, 507; **74**, ii, 91, 95; **75**, ii, 96.

Distances from Ohio River, via Kanawha and Richmond to tide water, **71**, 635, 650; **73**, 830, 833, 837; **77**, 677, 679.

Tows, width of, **75**, ii, 96.

Appalachian coal fields, resources of, **77**, 306.

Salt deposits of West Virginia, resources of, **77**, 320.

Objections to movable dams considered, **77**, 745.

Advantages of the several locks and dams, **79**, 548.

Transportation companies of West Virginia, **77**, 326.

Increasing with river improvement, **93**, 2578; **94**, 1952; **95**, 2448; **96**, 2248.

**Contracts.**[b]

**1873.** J. Rouch, dams and dikes on Cabin Creek, Elk, and Two-Mile Shoals, **73**, 507; completion of, except Cabin Creek, **74**, 66.

**1875.** D. M. & C. P. Dull, building lock No. 5 (for dam near Brownstown), **76**, 91, ii, 153, 155; **77**, 61, 296. Delay from improper management, **76**, ii, 158. C. McCafferty, building lock No. 4 (for dam near foot of Cabin Creek Shoals), **76**, 91, ii, 153, 156; **77**, 61, 296. Delay from lack of capital, **76**, ii, 159; **78**, 467, 470.

**1876.** Schultz & Jolliffe, building dam, abutment pier, and floor of navigable pass adjoining lock No. 5, **76**, 91, ii, 153, 157; **77**, 296. Work abandoned by contractor October, 1878, **79**, 549, 554.

**1877.** Freeman, Richards & Frazer, building dam, abutment pier, and floor of navigable pass adjoining lock No. 4, **77**, 61, 296, 298. Contract annulled July 1, 1878, **78**, 467, 470. W. M. Archer, ironwork for navigable pass and weir on dam adjoining lock No. 5, **77**, 61, 296, 299. Work contracted at prices less than estimated cost, **76**, ii, 165; **77**, 297.

**1878.** Ramsey & Latrobe, ironwork in pass and weir at dam No. 4, **78**, 467, 469, 471. Edge Moor Iron Co., iron gates for lock No. 5, **78**, 468, 469, 472.

**1880.** W. D. Lewis, timber, **80**, 683. H. L. Fearing, proof chain, 7.94 cents per pound, **80**, 684. Harris & Black, materials and labor for lock No. 6, **81**, 916.

**1881.** J. E. Thayer, tugboat hull, **81**, 916. J. Gilliland, construction of

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[a] Temporary improvement.

[b] PROPOSALS:

1873. For temporary improvement, by dams and dikes, on Cabin Creek, Elk, and Two-Mile Shoals, **73**, 506.
1875. Permanent improvement, for building locks Nos. 4 and 5, **76**, ii, 155.
1876. For building dam, etc., to lock No. 5, **76**, ii, 157. For culvert pipes and lock gates rejected, **77**, 297. For ironwork for movable dam No. 5, **77**, 299.
1877. For building dam adjoining lock No. 4, **77**, 298.
1878. For ironwork at dam No. 4 and iron gates for lock No. 5, **78**, 469.

## GREAT KANAWHA RIVER, W. VA.—Continued.

houses and locks 3 and 5, **82**, 924. J. Morgan, construction of house at lock No. 4, **82**, 924.

**1882.** J. E. Thayer, side-dumping scow, **82**, 925.

**1883.** F. Hefright, part construction of lock No. 2, **83**, 708. D. Egan, lock-house construction, **83**, 709. D. Egan, lock house construction, **84**, 930.

**1884.** Harold, McDonald & Co., foundation, pier, and abutment construction, **85**, 1848. O. A. & W. T. Thayer, iron, **85**, 1848.

**1885.** C. H. Strong & Son, lock construction, **85**, 1849. Snead & Co. Iron Works, iron, **85**, 1850. Martz, Kulp, McWilliams & Co., gate and wickets, **86**, 1592.

**1886.** Ainslie, Cochran & Co., lock gates, **86**, 1592. West Lebanon Rolling Mill Co., chain, **86**, 1593. T. W. Farley, telephone poles, 75 cents, **87**, 914. H. Crawford, lock house construction, **87**, 1914. Layten & F. C. Williams, crane boat construction, **87**, 1915. J. E. Thayer, fuel boat construction, **87**, 1915.

**1887.** Ainslie, Cochran & Co., ironwork, $4,184, **88**, 1750. W. D. Lewis, timber, $26 per M f., **88**, 1751.

**1888.** D. Eagan, completing lock house No. 2, $516, **88**, 1751. D. Eagan, lock house and outbuildings, $2,606, **89**, 1942. L. Williams, guard cribs at lock No. 2, $4,328, **89**, 1943. Carkin, Stickney & Cram, lock No. 7, $136,095, **89**, 1944.

**1889.** L. Williams, dump boat, $1,405.50, **89**, 1944. C. T. McDonald, lock No. 8, $123,935, **90**, 2239. Queen City Bridge & Steam Forging Co., lock ironwork, $3,751, **90**, 2239.

**1890.** Mumford & Reynolds, dam No. 7, $113,515, **91**, 2415.

**1891.** Russell Wheel & Foundry Co., ironwork for anchorage and fixed parts of movable dams Nos. 7 and 8, $11,750.50, **91**, 2416.

**1892.** F. J. Myers Mfg. Co., ironwork, $29,025.85, **92**, 2045. H. T. Morrison & Co., ironwork for lock gates Nos. 7 and 8, $7,363.60, **93**, 2579.

**1893.** Zimmerman, Truax & Sheridan, lock and dam No. 9, $283,344, **93**, 2580; lock and dam No. 10 $232.441, **93**, 2584. L. Williams, dump boat, $1,690, **93**, 2583. J. M. Mays, 2 lock houses and outbuildings, $5,672.50, **93**, 2583. West End Rolling Mill Co., chains for dams Nos. 7 and 8, $1,558.95, **93**, 2583. T. Munford, lock and dam No. 11, $526,895, **93**, 2585. M. V. Smith, lock house No. 11, $1,624, **94**, 1952.

**1894.** Youngstown Bridge Co., ironwork for dams Nos. 9, 10 and 11, $32,073.40, **94**, 2449. D. Eagan, 5 houses for lock hands at locks Nos. 7 and 8, $3,655.75, **95**, 2449.

**1895.** Youngstown Bridge Co., ironwork for dams Nos. 9, 10 and 11, $20,371.40, **96**, 2250. G. M. Donaldson, timber for gates and wickets of locks and dams Nos. 9, 10 and 11, $6,312.88, **96**, 2250.

**1896.** Fort Pitt Bridge Works, ironwork for gates of locks Nos. 9, 10 and 11, $9,250.42, **97**, 2570.

**1897.** H. B. Newhall, chains and clevises for movable dams, $1,300.69, **98**, 2121.

**1898.** H. Dilcher, 6 lock houses, locks Nos. 9 and 10, $4,169.64, **98**, 2120. Calderwood & Hanna, 3 service boats, $1,230, **98**, 2121.

**1899.** W. H. Hanna, crane boat, $1,250; W. L. Alderson and T. S. Neil, lock house at lock No. 11, $817.50; Neil & Hamm, lock houses and outbuildings at locks Nos. 2, 3, 4, 5 and 6, $6,601.70, **99**, 2480, 2481.

**Documents.** (Not printed in reports.) S. Doc. 25, 42d Cong., 3d sess., **73**, 508.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **72**, 74; **73**, 59; **74**, 56; **75**, 89; **76**, 91; **77**, 61; **78**, 67; **79**, 79; **80**, 108, 684; **81**, 145; **82**, 142, 930; **83**, 146; **84**, 149; **85**, 285; **86**, 279; **87**, 249; **88**, 222, 223; **89**, 258, 260; **90**, 232, 233; **91**, 299, 300; **92**, 286, 287; **93**, 324; **94**, 297; **95**, 332; **96**, 289; **97**, 381; **98**, 363; **99**, 427; **1900**, 490.

BOARDS OF ENGINEERS:

1875. On the project submitted by Maj. W. P. Craighill for improvement from mouth to Great Falls. Board recommend slack-water improvement by means of 9 movable dams (with locks) from mouth to Paint Creek Shoals and 3 permanent dams at and above Paint Creek Shoals (unless it be deemed advisable to make the whole or a part of the latter movable). Dimensions of locks from 285 to 300 f. long, from 48 to 50 f. wide. In the movable dams the Chanoine wicket to be used at first, with navigable pass 300 f. wide. Appropriation of 1875 ($300,000) to be applied to the construction of 2 locks (dams to be movable and constructed with future appropriations), one at or near Brownstown, the other between that point and Paint Creek Shoals. **75**, 89, ii, 95; **76**, ii, 164; **77**, 676; **79**, 551. (Lt. Col. H. G. Wright and Majs. W. P. Craighill and O. M. Poe, **75**, 89, ii, 95.)

Convened at Detroit, Mich., June 21, 1882, by S. O. No. 24, to report upon work of improvement completed, in prog-

## GREAT KANAWHA RIVER, W. VA.—Continued.

ress, and proposed, **82**, 926. (Lt. Col. Comstock, Majs. Weitzel and Merrill, and Capt. Turtle.)

ENGINEERS IN CHARGE:

Maj. W. E. Merrill, 1873–74; **73**, 58. Reports, **73**, 505; **74**, 483.

Maj. W. P. Craighill, 1874–95; **74**, 66, 483; **75**, 89, ii, 87, 633. Reports, **73**, 835; **75**, ii, 87, 90, 631; **76**, ii, 153; **77**, 296; **78**, 467; **79**, 545; (Col.), **80**, 681, 685; **81**, 911; **82**, 919; **83**, 706; **84**, 928; **85**, 1845; **86**, 1589; **87**, 1911; **88**, 1749, 1756; **90**, 2237, 2246; **91**, 2413, 2425; **92**, 2041, 2062; **93**, 2577; **94**, 1951; **95**, 2447 (Brig. Gen.).

Capt. T. Turtle, 1889. Report, **89**, 1941, 1954.

Lt. Col. P. C. Hains, 1895–96. Reports, **95**, 2447; **96**, 2247.

Maj. J. F. Gregory, 1897. Reports, **97**, 2566.

Maj. W. H. Bixby, 1898–99. Reports, **98**, 2118.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2499; **1900**, 3322.

ASSISTANTS:

E. Lorraine, report, **73**, 835.

A. M. Scott, **74**, 483; **75**, ii, 87, 634; **76**, ii, 154; **77**, 296; **78**, 468. Reports, **73**, 507; **75**, ii, 88; **76**, ii, 157; **77**, 303, 684, 709.

H. Bacon, **75**, ii, 87.

W. R. Hutton, **77**, 296, 675; **78**, 468. Reports, **76**, ii, 154; **77**, 727, 749.

Lt. T. Turtle, **77**, 675. Reports, **77**, 299, 709; **78**, 469; **79**, 548, 550; **80**, 686.

Capt. E. H. Ruffner. Reports, **81**, 911; **82**, 920.

A. M. Scott. Reports, **83**, 710; **84**, 930; **85**, 1850, 1855; **86**, 1594; **87**, 1915; **88**, 1751; **89**, 1945, 1952; **90**, 2240; **91**, 2417; **92**, 2045, **93**, 2586; **94**, 1953; **95**, 2450; **96**, 2250; **97**, 2570; **98**, 2121; **99**, 2483; **1900**, 3324.

**Estimates.** (See *Plans* and *Projects.*)

J. A. Byers, 1868, mouth to Great Falls, masonry, dams, and locks, $1,867,072; or timber crib dams and masonry locks, $1,494,544; or timber crib dams and locks, $1,335,280, **77**, 803, 806; or side canal, with locks, from mouth to Brownstown; thence slack-water navigation, by masonry locks and dams, $2,048,580, **77**, 803; or by masonry locks and dams at Lyken's, Paint Creek, and Cabin Creek Shoals, with sluice dams at other points, $743,820, **77**, 803.

W. R. Hutton, 1871, mouth to and above Lyken's Shoals (85 miles), sluice dams, openings 100 f. by 7 f. aiding low water by discharge from meadow reservoir; estimate, $973,900, **71**, 627, 642, 650.

E. Lorraine, 1872, mouth to Paint Creek Shoals, low water sluice dams; thence to Great Falls by locks and dams; estimate, $1,979,172, **73**, 836, 841; **74**, ii, 101; or by locks and dams throughout, $2,918,453, **75**, ii, 637.

A. M. Scott, 1873, estimated cost of lock and dam at Paint Creek Shoals, lock 255 f. by 50 f., stone lock with timber dam $224,000; stone lock with stone dam, $261,000, **73**, 508. Reported by Maj. Craighill as too low, **73**, 509.

A. M. Scott, revising estimate of Lorraine, 1872, mouth to foot of Paint Creek Shoals, sluice dams, aided by reservoir discharge; thence to Great Falls by 4 stone locks and dams, $2,350,000, **77**, 746; or by locks and dams throughout, $3,077,113, **75**, ii, 91, 93, 638; **77**, 747; or by 7 movable dams, with locks, mouth to Brownstown; thence to Great Falls by 5 permanent dams with locks, $3,894,183, **77**, 748.

Maj. W. P. Craighill, 1875, mouth to foot of Great Falls, 12 permanent dams with locks, $3,077,113; or by 9 permanent dams with locks, $2,739,440; or 9 movable dams and 3 permanent dams, $4,071,216, **75**, ii, 91, 93, 94, 638. For permanent dam, lock 14 f. lift, at or near Brownstown, $237,000, **75**, ii, 92, 94; or movable dam, lock 8 f. lift, $286,000, **75**, ii, 92, 94.

Revised estimate of project approved by Board of Engineers, 1875, for 9 movable and 3 permanent dams, with locks, $4,152,500, **76**, 91, ii, 154, 165; **77**, 297, 676, 747, 751; **78**, 469. Estimated prices in excess of contracts, **76**, ii, 165; **77**, 297, 751.

Estimate reduced $600,000, 1879, by reduction of locks and dams near Charleston and omission of lock No. 1. Amount required to complete existing project, $2,610,000. **79**, 80, 550.

**Legal proceedings.**

Additional purchases of land at locks Nos. 4 and 5, **94**, 1961.

The sum of $2,214 awarded in the Court of Claims to M. Alfred Pasqueau, for use of his patented heurter in certain dams, **1900**, 3323.

Suits were filed by contractors, for locks 7, 9, and 10, for certain sums due for extra work on contracts, **1900**, 3323.

**Legislation.**

Suggested, concerning Great Kanawha, **77**, 678.

Act of legislature (1869) defining and enlarging powers of Kanawha board, **77**, 808.

Act of Congress (1872) providing for transfer to U. S. of certain rights, franchises, etc., by West Virginia, **77**, 813.

Act of legislature (1875) giving consent to, **77**, 814.

Act of Congress (1875) providing for

## GREAT KANAWHA RIVER, W. VA.—Continued.

condemnation of land for public use, **77**, 815.

Act proposed by Col. Craighill to provide for the operation, maintenance, and repairs of the locks and dams, **80**, 685. Rejected by Congress, **81**, 147.

Proposal of West Virginia to abandon jurisdiction of river to U. S. refused by Secretary of War, **82**, 919.

**Operations.** (See *Great Kanawha River, Operating and Care.*)

Previous to 1873 carried on by Kanawha Board and Kanawha River Improvement Co., and consisted in dredging narrow chutes through shoals, aided by construction of short wing dams, **73**, 505, 507, 839; **77**, 807. Insufficiency of work done, **73**, 507, 839.

**1873–74.** Temporary improvement by construction of wing dams at Elk and Two-Mile shoals, by contract, widening chute at Elk Shoals, and removing obstructions in lower river, by hired labor, **73**, 507; **74**, 66, 483.

**1874–75.** Temporary improvement by construction of wing dams at Bousemans Island, Elk, Two-Mile, Johnson, and Knob shoals by hired labor; removal of obstructions by U. S. crane boat; dredging on bars by State dredges, **75**, 89, ii, 87, 88.

**1875–76.** Temporary improvement by work on Charleston, Elk, Two-Mile, and Red-House shoals by hired labor; removal of obstructions by U. S. crane boat; dredging on bars by State dredges, **76**, 91, 154, 158, 162; **77**, 303. Permanent improvement, construction of dams (movable) Nos. 4 and 5, also lock No. 4, by contract, **76**, 91, 154, 158, 162; **77**, 303.

**1876–77.** Temporary improvement by work at Red-House Shoals, **77**, 61, 296, 299, 300. Permanent improvement, progress on locks and dams (movable) Nos. 4 and 5 by contract, **77**, 61, 296, 299, 303.

**1877–78.** Temporary improvement by removal of bowlders from shallows of lower river by hired labor and use of crane boat, **78**, 472. Permanent improvement, commencement of work by hired labor on lock and dam No. 3, **78**, 67, 467, 470. Progress at locks Nos. 4 and 5 by contract, **78**, 67, 467, 470, 471. Failure of contractor at dam No. 4 and prosecution of work by hired labor, **78**, 67, 467.

**1878–79.** Temporary improvement by repair of Two-Mile Dam, **79**, 554. Permanent improvement; progress on lock and dam No. 3 delayed by labor strikes, **79**, 79, 549, 552; completion of lock No. 4; progress on dam No. 4, **79**, 79, 549, 552. Completion of lock No. 5; abandonment of dam No. 5 by contractor and progress by hired labor, **79**, 79, 549, 551, 553. History of previous operations, **79**, 550.

**1879–80.** Lock and dam No. 3: Stone prepared; cofferdam placed; excavation and masonry commenced for lock; 12,839 c. y. masonry built. Lock and dam No. 4: Lock ready for gates; 120 l. f. of retaining crib built; pass, pier, and river walls completed; cofferdam nearly finished. Dredging lock and dam No. 5: Dredging of lock approaches; bulkheads built across ends of lock; masonry work completed. **80**, 686, 687, 688.

**1880–81.** Lock and dam No. 3: Masonry work on river wall completed; 2,200 y. paving on land and land wall laid; cribs at foot of lock completed. Lock and dam No. 4 completed and in working order. Lock and dam No. 5 completed and in working order. **81**, 911, 912, 913.

**1881–82.** Lock and dam No. 3: Land wall bolted to foundation rock; 280 l. f. of foundation crib work for dam constructed; 560 l. f. of foundation trench dredged; 10,000 c. y. stone placed in dam. Locks and dams 4 and 5 in operation. Lock and dam No. 6: 3,441 c. y. masonry placed. **82**, 920, 921, 922, 923.

**1882–83.** Lock No. 2 (for stationary dam): Work commenced under contract. Locks 3, 4, and 5 in operation, and lock 6 nearly finished; dredging. **83**, 710, 711, 712, 713.

**1883–84.** Lock No. 2: 17,500 c. y. dredged; cofferdam built; masonry bed rock prepared and lock house built. Lock No. 6 completed and dam for same commenced, **84**, 930, 931, 933.

**1884–85.** Lock No. 2: Construction advanced by 9,922 c. y. masonry placed and 9,180 c. y. excavation. Dam No. 6: Masonry work and second section of cofferdam completed, **85**, 1850, 1851, 1853.

**1885–86.** Lock No. 2 and dam No. 6 nearly completed; dredging, **86**, 1595, 1597.

**1886–87.** Locks and dams 2 and 6 completed and put in operation, **87**, 1912.

**1887–88.** Lock and dam No. 2 completed and put in operation; banks riprapped at lock No. 3; repairs to lock; two sunken barges in the Charleston Pool and one near lock No. 3 removed; repairs to plant, **88**, 1751, 1755.

Operation and care of locks and dams, **88**, 1756.

**1888–89.** 2,180 c. y. riprap used in repair of banks at lock and dam No. 2; cribs built at head of lock No. 2, and lock house completed; minor repairs to movable dams; lock house built, and construction of lock No. 7 begun; dredging at lock No. 2, Harveys Shoal, Witchers

**GREAT KANAWHA RIVER, W. VA.**—Continued.

Creek Shoal, Scary Shoal, **89**, 1945, 1949.
Operation and care of locks and dams, **89**, 1954.
**1889–90.** Cofferdams, excavation, and foundation for lock No. 7 completed, and main walls begun; construction of lock No. 8 begun; lock house built; 2,813 c. y. riprap placed in repair of lock No. 2; new lower gates placed in lock No. 3, and repairs to locks 4, 5, and 6 of the movable dams; dredging and snag removal, **90**, 2240–2245.
Operation and care of locks and dams, **90**, 2246.
**1890–91.** Excavation for foundations; 528 c. y. concrete and 104 c. y. masonry laid; preparation of material for dam at lock and dam No. 7; 4,500 c. y. masonry laid in construction of lock and dam No. 8.
Operation and repair of locks and dams. **91**, 2417–2425.
**1891–92.** Locks 7 and 8 completed (except gates), and foundations for dams 7 and 8 in progress; repairs to locks 4 and 5; dredging and repairs to plant, **92**, 2045, 2052.
Operation and care of locks and dams, **92**, 2062.
**1892–93.** Construction of masonry and foundations of locks and dams Nos. 7 and 8; preparations for work on Nos. 9, 10, and 11; completed works operated; some dredging done; plant repaired and additions made thereto; snags and other obstructions removed; and lock houses under construction, **93**, 2586–2593.
**1893–94.** Locks and dams Nos. 7 and 8 completed; construction of Nos. 9 and 10 commenced; completed works operated; about 35,000 c. y. dredged; telephone line extended; miscellaneous work done, **94**, 1953–1961.
**1894–95.** Construction of foundations and masonry of locks and dams Nos. 9, 10, and 11; completed works operated and cared for; 27,000 c. y. dredged, and snags and other obstructions removed; miscellaneous work done, **95**, 2450–2457.
**1895–96.** Construction of foundations and masonry of locks and dams Nos. 9, 10, and 11 (photographs); completed works operated; 38,500 c. y. dredged; snags and other obstructions removed; miscellaneous work done, **96**, 2250–2259.
**1896–97.** Construction of foundations and masonry of locks and dams Nos. 9, 10, and 11 (photographs); about 12,000 c. y. dredged; some obstructions removed, **97**, 2568–2574.
**1897–98.** Locks and dams Nos. 9, 10, and 11 almost completed (photographs); miscellaneous work done; 52,470 c. y. dredged; some obstructions removed, **98**, 2119.
**1898–99.** Locks and dams Nos. 9, 10, and (maps) 11 finished, completing the entire system of locks and dams; lock houses, tool houses, and shops, etc., built and 25,500 c. y. dredged; 750 c. y. bowlders and some snags removed from river, **99**, 2483.
**1899–1900.** 16,760 c. y. dredged and 1,585 c. y. bowlders removed; new crane boat and new houses for lock tenders built, and minor repairs made to plant, **1900**, 3322.

**Physical characteristics.**
Fall of river, **71**, 642; **73**, 837; **75**, ii, 91, 95; **76**, ii, 159, 163; **77**, 744, 749.
Discharge of, **71**, 641; **73**, 839; **75**, ii, 92; **76**, ii, 160, 163; **77**, 745, 749, 802, 807; **78**, 473.
Comparison of low-water slope and discharges of, with Seine, **76**, ii, 163; **77**, 749.
Floods on, **76**, ii, 163; **77**, 749, 802; **78**, 473.
Width and character of bed, **73**, 839; **75**, ii, 91; **76**, ii, 163.
Regimen, as affected by floods in New River, **77**, 296, 303.
Character of rock at lock foundations, **77**, 300.
Geology of coal basins on, **77**, 306.
Salt deposits of West Virginia, **77**, 320.
Kanawha River begins at junction of Gauley and New rivers, **73**, 837, 844; **74**, ii, 93.
Compressive strength, specific gravity, and ratio of absorption of Great Kanawha sandstones, **89**, 1951.
Quicksand hindering work on dam No. 11, **98**, 2119.

**Plans.** (See *Estimates* and *Projects.*)
1817–19. For a connection between the Ohio and James rivers, via Kanawha, **71**, 625, 636.
By Capt. McNeil, U. S. T. E., 1826–28, for a connection between the Ohio and James rivers, via Kanawha, **71**, 625, 636; **77**, 677, 762.
By James River & Kanawha Canal Co., 1832, for connection between the Ohio and James rivers, via Kanawha River, **71**, 625, 650.
By E. H. Gill, 1838–41, improving Kanawha with system of locks from pool to pool, **71**, 636, 640; **77**, 803.
By Mr. Fish, 1855, system of dams at pools provided with sluices—dams at intervals of about ½ mile—grading the river to a nearly uniform slope, **71**, 637, 642; **73**, 839; **77**, 745.
By C. Ellet, 1860, system of sluice dams, aiding low-water depth by reser-

voir discharge, **71**, 637; **73**, 839; **77**, 745.

By J. A. Byers, 1868, mouth to Loup Creek Shoals, 5 miles below Great Falls, to 5 f. depth low water, by 12 locks and dams, slack-water locks 200 f. by 40 f.; or combination of locks and dams, slack water, with side canals to pass most difficult points, with locks at foot of shoals and dams at head; or by locks and dams at Paint Creek, Lyken's, and Cabin Creek Shoals, together with low-water dams provided with sluice opening 110 f. wide; grading the river to a slope not exceeding 3 f. fall per mile, **77**, 803, 806.

By E. Lorraine, 1872, mouth to Great Falls, slack-water navigation, 12 locks and dams, locks 240 f. by 40 f. by 7 f., **73**, 840; **75**, ii, 91, 93, 638; **77**, 746; **79**, 550. Objections to sluice system of navigation, **73**, 507, 509, 839; **77**, 748.

By A. M. Scott, 1875, revising plan of E. Lorraine (1872), locks increased to 280 f. by 40 f. by 7 f., **75**, ii, 91, 93, 638; **77**, 746; or 7 movable dams, with locks, mouth to Brownstown; thence by 5 permanent dams, with locks, to foot of Great Falls; movable dams, with navigable pass 250 f. wide; all locks 280 f. by 50 f. by 7 f., **77**, 747.

**Private (State and corporate) work.**

In 1832 the James & Kanawha River Canal Co. was formed, **71**, 625, 635, at which time the Kanawha River was a part of their property.

In 1858 the Kanawha board was created for the improvement of Kanawha River from mouth to Loup Creek Shoals, subject to instructions of the James & Kanawha River Canal Co.

In 1869 West Virginia annulled all rights of the canal company to Kanawha River and placed it entirely under control of Kanawha board.

In 1875 West Virginia transferred to the United States all rights, etc., on Kanawha River and its tributaries to mouth of Howard and Anthony creeks (see *Legislation*), **77**, 807, 813.

Work done by Kanawha board, **73**, 839; **75**, ii, 89; **76**, ii, 161; **77**, 303.

**Projects.** (See *Estimates* and *Plans*.)

By W. R. Hutton, 1871, mouth to Lykens Shoals, 85 miles (as a part of third division "Central route" of transportation routes to seaboard) to a low-water depth of 7 f. by sluice dams; grading the river, with openings 100 f. by 7 f.; aiding low-water discharge by reservoir on Meadow Creek, **71**, 627, 642; estimate $973,900, **71**, 627, 642, 650.

By E. Lorraine, 1872, mouth to Great Falls, to 7 f. depth at low water, as follows: Mouth to foot of Paint Creek Shoals by timber crib, low-water dams, provided with sluice openings 120 f. by 6½ f., and arranged to grade surface of river to slope of 2 f. per mile; low-water discharge of river to be increased by reservoirs; foot of Paint Creek Shoals to Great Falls by slack-water navigation, with 4 locks and dams, locks 240 f. by 40 f., **73**, 836, 840; **75**, ii, 91, 93, 638; **77**, 746; **79**, 550. Adoption of, recommended by Maj. Craighill, **73**, 836; estimate $1,979,172, **73**, 836, 841; **74**, ii, 101. Revised by A. M. Scott, 1875, increasing dimensions of locks to 280 f. by 50 f., **77**, 745; estimate $2,350,000, **77**, 746.

By Maj. Merrill, 1873, proposes lock and dam at foot of Paint Creek Shoals, lock 225 f. by 50 f., 13 f. lift; indorsed the project for improvement above Paint Creek Shoals with locks and dams, **73**, 508.

By Maj. Merrill, 1874, temporary improvement below Paint Creek Shoals with riprap dams; removing obstructions, in connection with dredging by the Kanawha board; work to be done by hired labor largely, **73**, 59, 506.

By Maj. Craighill, 1875, mouth to Great Falls, 94.2 miles, low-water depth of 7 f.: 1st, with locks with permanent dams; 2d, with locks with movable dams; 3d, by a combination of the two. By the first plan 9 or 12 locks and dams would be required, with an aggregate lift of 108 f.; locks from 285 f. to 300 f. long and from 48 f. to 50 f. wide; estimate $2,739,440 to $3,077,113. If movable dams be used the lift should be limited to 8 f. By the third, or a combination of permanent and movable dams, the arrangement would be: 9 movable dams between mouth and Paint Creek Shoals and 3 permanent dams between Paint Creek and foot of falls; estimate $4,071,216. Movable dams provided with a navigable pass of from 250 f. to 300 f. and closed with the Chanoine wicket; the first dam built to be movable and located at or near Brownstown, **75**, 89, ii, 90, 95.

Board of Engineers (1875) recommended adoption of movable dams from mouth to Paint Creek and permanent dams above that point, unless best to make whole or part movable; estimate $4,152,500. Further recommended dimensions, suggested by Maj. Craighill, together with the adoption of Chanoine wicket (see *Board of Engineers*), **75**, 89, ii, 90, 95; **76**, ii, 158, 163, 164; **77**, 303, 676.

Objections to movable dams considered, **77**, 745.

Dimensions of locks and dams in progress, **79**, 547.

## GREAT KANAWHA RIVER, W. VA.—Continued.

Omission of lock and dam No. 1, **79**, 550.

Recommendation of Board of Engineers of 1882, **82**, 828, 829.

In 1886 locks and dams Nos. 3, 4, and 5 were completed, and lock and dam No. 6, with No. 2 nearly completed, **86**, 280.

Amount appropriated for permanent improvement, $1,929,500; amount required to complete project, $1,670,000, **86**, 281.

In 1889 the amount estimated for completion was reduced to $970,000, **89**, 1942.

In 1892 Col. Craighill estimated the cost of completing the slack-water improvement on the Great Kanawha, by completion of locks and dams 7 and 8, construction of three additional locks and dams, construction of lock houses, and dredging, at $1,305,700, **92**, 2043, 2056.

Construction of works under continuous contract sanctioned by act of 1892, **93**, 2588.

Description of proposed locks and dams, **93**, 2588.

In 1896 Lt. Col. Hains estimated that, largely because of the 8-hour law, $273,000 additional would be required for the completion of locks and dams Nos. 9, 10, and 11, **97**, 2568, 2569.

**Secretary of War.**

Report, **80**, 648.

**Surveys.**

By E. Ellet, 1838, **71**, 625, 636; **77**, 743, 749.

By J. A. Byers, 1856, **76**, ii, 163; **77**, 743, 749.

By A. M. Scott, 1873, **74**, 485; **76**, ii, 163.

By A. M. Scott, 1874, **75**, ii, 634.

By A. M. Scott, 1875–76, to determine exact location of locks and dams recommended by Board of Engineers, 1874, **76**, ii, 154, 157, 163; **77**, 296, 303, 676.

To determine effects of freshets in New River on regimen of Kanawha, **77**, 61, 296, 303. Profile of river from mouth to Great Falls, **76**, ii, 164.

To determine location of lock and dam sites, **78**, 473.

Completion below Charleston, **79**, 554.

For location of dams 6 and 7, **80**, 689.

For location of lock and dam No. 2, **81**, 915.

MAPS. (See *Operations.*) **80**, 682; **89**, 1951; (photographs) **96**, 2250; **97**, 2568; **98**, 2119; **99**, 2483.

## GREAT KANAWHA RIVER LOCKS AND DAMS. (Operating and care.) (See also *Great Kanawha River.*)

**Appropriations.**[a]

| | |
|---|---|
| 1885, | $5,811.51. |
| 1886, | 8,175.04. |
| 1887, | 11,349.09. |
| 1888, | 14,417.62. |
| 1889, | 19,399.35. |
| 1890, | 22,057.30. |
| 1891, | 23,835.57. |
| 1892, | 22,003.96. |
| 1893, | 19,564.91. |
| 1894, | 28,745.60. |
| 1895, | 29,983.04. |
| 1896, | 30,713.95. |
| 1897, | 26,868.30. |
| 1898, | 23,322.19. |
| 1899, | 34,547.44. |
| 1900, | 45,215.73. |
| Total, | 366,010.60. |

**Commerce.** (See *Physical characteristics.*)

Coal trade greatly assisted by pools in Kanawha River, **1900**, 3325.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 326; **94**, 299; **95**, 334; **96**, 290; **97**, 383; **98**, 365; **99**, 429; **1900**, 492.

ENGINEERS IN CHARGE:

Col. Wm. P. Craighill, 1874–95. Reports, **93**, 2594; **94**, 1962; **95**, 2458 (Brig. Gen.).

Lt. Col. P. C. Hains, 1895–96. Reports, **95**, 2458; **96**, 2260.

Maj. J. F. Gregory, 1897. Report, **97**, 2575.

Maj. W. H. Bixby, 1898–99. Report, **98**, 2129.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2485; **1900**, 3325.

ASSISTANTS:

A. M. Scott. Reports, **97**, 2575; **98**, 2135; **99**, 2493; **1900**, 3334.

T. E. Jeffries. Report, **1900**, 3337.

**Operations.**

For details of routine work see references to *Engineers in charge.*

**1897–98.** 3 wrecks removed and 1,240 c. y. dredged, **98**, 2129.

**1898–99.** About 8,700 c. y. dredged and some snags removed, and minor repairs made to locks and dams, **99**, 2494.

**1899–1900.** 29,640 c. y. dredged, 1 wreck and some snags removed, and repairs made to lock No. 4 and dam No. 6, **1900**, 3325.

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[a] Expenditures under permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## GREAT KANAWHA RIVER LOCKS AND DAMS. (Operating and care)—Continued.

**Physical characteristics.**

Ice suspending navigation, **98**, 2129.

Small rises in Ohio River augmented by water from Kanawha River pools sufficiently to move waiting coal craft to market, **1900**, 3325.

**Projects.**

List of dams, **98**, 2129.

**GREAT LAKES.** (See *Erie Canal, N. Y.; North-Northwestern Lakes in Miscellaneous Index, Vol. 3; St. Marys River, Mich.; Transportation Routes to the Seaboard.*)

## GREAT LAKES. CHANNELS CONNECTING BUFFALO, CHICAGO, AND DULUTH.

**Appropriations.**

| | | |
|---|---|---|
| 1892, | $375,000, | **93**, 2962. |
| 1893, | 875,000, | **95**, 2865. |
| 1895, | 500,000, | **95**, 2865. |
| 1896, | 500,000, | **96**, 2754. |
| 1897, | 1,090,000, | **97**, 2959. |
| Total, | 3,340,000 | |

**Commerce.**

In 1897 the Lake Carriers' Association sent a letter to the Secretary of War suggesting what further improvement was deemed necessary for the benefit of commerce, **97**, 2960.

Very large and important, **91**, 2811, 2817; **99**, 505; **1900**, 569.

**Contracts.**

**1892.** Channel excavation, per c. y.: Bank measure—R. J. Cram, 44 cents ($39,600); C. E. Mitchell & Co., 25.9 cents ($98,420), **93**, 2967; John Hickler, $2.43 and 22 cents ($219,589.38 and $14,740), **93**, 2968. Scow measure—McCollum & Lee and R. J. Cram, 58 cents ($148,480), **93**, 2968; James Rooney, 16½ cents ($156,750); Breymann Bros., 14⅞ cents ($431,375); L. P. & J. A. Smith, 18 cents ($195,480), **93**, 2969.

**1894.** L. P. & J. A. Smith, excavating rock, $2.24 per c. y., bank measure; other material than rock, 95 cents per c. y., s. m. ($11,453.65), **95**, 2866.

**1895.** W. A. Gillis & Co., earth excavation, 65 cents per c. y.; rock excavation, $3.75 per c. y. ($7,075), **96**, 2755.

**1897.** M. Sullivan, dredging and submarine rock excavation, 52 and 98 cents per c. y., bank measure, **98**, 2553.

**1898.** M. Sullivan, removal of obstructions, $2.15 per c. y., and $2.60 per s. t. ($103,500). J. Rooney, furnishing and operating dredging plant, $9 per hour, **98**, 2553.

**1892–98.** List of bidders for various miscellaneous supplies, **93**, 2970; **94**, 2267; **96**, 2755.

**Engineers.**

Chief of Engineers. Reports, **91**, 362; **93**, 389; **94**, 361; **95**, 397; **96**, 351; **97**, 435; **98**, 424; **99**, 505; **1900**, 569.

Engineers in Charge:

Col. O. M. Poe, 1891–95. Reports, **91**, 2811; **93**, 2962; **94**, 2261; **95**, 2859.

Lt. Col. G. J. Lydecker, 1896–. Reports, **96**, 2749; **97**, 2955; **98**, 2548; **99**, 2953; **1900**, 3947.

Assistants:

C. Y. Dixon. Reports, **96**, 2755; **99**, 2957.

J. Ripley. Report, **99**, 2957.

B. Rohnert. Report, **1900**, 3948.

**Operations.**

**1892–93.** Work on all eight sections in progress, about 230,000 c. y. being dredged, **93**, 2965.

**1893–94.** About 1,800,000 c. y. dredged, **94**, 2265.

**1894–95.** Sections 1, 4, and 6 completed, and work on other sections in progress, about 3,000,000 c. y. in all being dredged, **95**, 2862.

**1895–96.** Nearly 3,000,000 c. y. dredged, **96**, 2753.

**1896–97.** Sections 2, 3, 5, and 7 completed, and work on section 8 in progress, about 1,300,000 c. y. in all being dredged, **97**, 2956.

**1897–98.** Increase of width and depth of channels through Round Island shoals, St. Marys River, in progress; removal of bowlders, rock, and other material from the channel in the lower section of Detroit River in progress; removal of dangerous shoal at foot of Mud Lake, St. Marys River, completed; part of Middle Ground shoal, Port Huron, St. Clair River, removed; channel through bar at mouth of Detroit River completed; in all, 312,267 c. y. being dredged, **98**, 2548.

**1898–99.** 240,307 c. y. dredged from Round Island shoals; over 80,000 c. y. removed from Detroit River; about 44,000 c. y. removed from St. Clair River, **99**, 2954.

**1899–1900.** Over 50,000 c. y. removed from Round Island shoals, and about 25,000 c. y. removed from Detroit River, **1900**, 3949.

**Physical characteristics.**

Description of, **91**, 2817; **98**, 2551.

## GREAT LAKES. CHANNELS CONNECTING BUFFALO, CHICAGO, AND DULUTH—Continued.

**Projects.**

In 1892 Congress adopted plan of Col. Poe, 1891, for the construction of a ship channel with navigable depth of 20 f., to connect the waters of the Great Lakes between Buffalo, Chicago, and Duluth, at an estimated cost of $3,340,000, as follows:

St. Marys River—(1) Round Island shoals, (2) Little Mud Lake, (3) reef abreast of Sailors Encampment Island, (4) and shoal below the island, 21 f. depth and 300 f. width; (5) 21 f. depth and a width of 2,400 f. at the foot of Lake Huron; (6) 20 f. depth from deep water in St. Clair River through St. Clair Flats Canal to Lake St. Clair, with a width above the canal not greater than 650 f., thence narrowing to the canal, thence for the full width of the canal for its entire length, thence gradually widening to 800 f. at deep water in Lake St. Clair; (7) 20 f. depth and a width of 800 f. through Grossepoint Flats, Lake St. Clair; (8) 21 f. depth and a width of 800 f. through the bar at the mouth of the Detroit River, **93**, 2962, 2963.

Detroit River provided for by separate appropriation, 1899, **99**, 2955.

Lt. Col. Lydecker estimated, 1899, it would cost $250,000 to supply data for reliable conclusions as to what would be needed for the preservation of lake channels and harbor depths, and suggested that such investigations be made in connection with surveys of the Northeastern and Northwestern lakes, **99**, 2956.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Col. Poe, **91**, 2811.

System of triangulation along Detroit River, **96**, 2757, 2758.

Minor surveys. See references to each annual report of officer in charge.

MAPS. **93**, 2962, 2964; **94**, 2266; **95**, 2866; **96**, 2758.

## GREAT LAKES, SHIP CANAL FROM, TO THE HUDSON RIVER. (Survey.)

**Appropriations.**[a]

| | | |
|---|---|---|
| 1895, | $10,000, | act Mar. 2. |
| 1897, | 150,000, | act June 4. |
| 1898, | 225,000, | act July 1. |
| 1899, | 90,000, | act Mar. 3. |
| 1900, | 20,000, | act Feb. 9. |
| Total, | 495,000. | |

**Commerce.**

Amount of tonnage to be benefited by ship canal, **97**, 3164.

Description of ocean, lake, and canal vessels that would probably use the proposed canal, **97**, 3172.

Description of miscellaneous freight business, **97**, 3179.

Commercial and military considerations, **97**, 3194.

Comparison of cost of transportation by proposed ship canal and existing Erie Canal, **97**, 3207; by improved Erie Canal, **97**, 3210.

Cost of transportation by barge canal, Erie Canal route, **97**, 3212.

Conditions, methods, and expenses attending the receipt, storage, transfer, and shipment of grain in the harbor of New York, **97**, 3219.

(See *Summary*, **97**, 3235.)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **97**, 472, 3128.

ENGINEER IN CHARGE. Maj. T. W. Symons, 1896. Report, **97**, 3130.

**Physical characteristics.**

Three probable routes for a ship canal entirely within the United States from the Great Lakes to the Hudson, and one route not wholly within the United States, **97**, 3129.

Detailed description of possible routes: Oswego route, **97**, 3135; Oswego-Hudson route, **97**, 3142; Erie Canal route, **97**, 3147; St. Lawrence-Champlain route, **97**, 3149.

(See *Summary*, **97**, 3235.)

**Projects.**

In 1897 Maj. Symons estimated it would cost $200,000,000 to build a canal of the character contemplated by the act of 1896, **97**, 3129; but was of the opinion that the enlargement of the Erie Canal of the State of New York was worthy of being undertaken by the Government, as the benefits to be derived therefrom would be properly commensurate with the cost, which was estimated to be approximately one-fourth that of a ship canal, and that the commercial advantages would be practically equal to those of a ship canal as proposed, **97**, 3130. (See *Summary*, **97**, 3235.)

**Surveys.**

The act of June 3, 1896, directed the Secretary of War to cause to be made accurate examination and estimates of cost of construction of a ship canal by the most practicable route wholly within the United States from the Great Lakes to the Hudson River, of sufficient capacity to transport the tonnage of the lakes to the sea, and such examinations were made by Maj. Symons in 1896–97 (see *Projects*), **97**, 3128.

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[a] See also H. Doc. 149, 56th Cong., 2d sess., for report of Board of Engineers on deep waterway.

## GREAT PECONIC BAY, N. Y. (See *Peconic River, N. Y.*)

## GREAT PEDEE RIVER, S. C.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $7,000, | **80**, 845. |
| 1881, | 6,000, | **81**, 1030. |
| 1882, | 6,000, | **82**, 1107. |
| 1884, | 8,000, | **84**, 1047. |
| 1886, | 20,000, | **86**, 170. |
| 1888, | 20,000, | **88**, 920. |
| 1890, | 12,500, | **90**, 1217. |
| 1892, | 10,000, | **92**, 1205. |
| 1894, | 6,000, | **95**, 1402. |
| 1896, | 12,000, | **96**, 1162. |
| 1899, | 4,000, | **99**, 1524. |
| Total, | 111,500 | |

**Commerce.**

Unimportant, **73**, 755; H. Doc. 68, 45th Cong., 3d sess., 17.

Description of, **93**, 1476; **94**, 1078; **95**, 1403; **96**, 1162.

The aggregate tonnage moved on the river in 1892-93 amounted to 94,661 t., **93**, 1474; in 1893-94, 91,025 t., **94**, 1077; in 1894-95, 106,115 t., **95**, 1401; in 1895-96, 229,964 t., **96**, 1161.

In 1899, sufficient to justify continued improvement and maintenance of stream, **99**, 1523.

**Engineers.**

Chief of Engineers. Report, **73**, 70; H. Doc. 68, 45th Cong., 3d sess., 1; **80**, 125; **81**, 166; **82**, 162; **83**, 169; **84**, 174; **85**, 172; **86**, 169; **87**, 135; **88**, 129; **89**, 153; **90**, 138; **91**, 172; **92**, 171; **93**, 185; **94**, 170; **95**, 194; **96**, 172; **97**, 216; **98**, 213; **99**, 246; **1900**, 279, 292.

Engineers in Charge.

Maj. Q. A. Gillmore. Report, **73**, 753.

Capt. C. B. Phillips. Report, H. Doc. 68, 45th Cong., 3d sess., 16. 1879-81. Report, **80**, 844.

Capt. J. Mercur, 1881-84. Reports, **81**, 1029; **82**, 1107; **83**, 866.

Capt. F. A. Hinman, 1884-85. Report, **84**, 1047.

Capt. W. H. Bixby, 1885-89. Reports, **85**, 1100; **86**, 1017; **87**, 1070; **88**, 920.

Capt. F. V. Abbot, 1889-97. Reports, **89**, 1179; **90**, 1215; **91**, 1450; **92**, 1203; **93**, 1474; **94**, 1076; **95**, 1401; **96**, 1160; **97**, 1447.

Maj. E. H. Ruffner, 1898-99. Report, **98**, 1269; **99**, 1523.

Capt. J. C. Sanford, 1900. Report, **1900**, 1847.

Assistants:

G. Daubeney, **73**, 753.

W. B. Page, H. Doc. 68, 45th Cong., 3d sess., 16, 17.

C. W. Forster. Report, **80**, 846.

H. Heth. Reports, **81**, 1029; **82**, 1108; **83**, 867.

R. Whitford. Reports, **85**, 1101; **86**, 1019; **87**, 1072; **88**, 923; **89**, 1180; **90**, 1217; **91**, 1452; **92**, 1205; **93**, 1475; **94**, 1078; **95**, 1402; **96**, 1162; **97**, 1449; **1900**, 1849.

**Expenditures.**

For examination, $103.40, **73**, 753.

**Operations.**

**1880-81.** 286 logs and trees removed from river channel at Pocket Landing, **81**, 1029.

**1881-82.** Removal of snags, trees, and obstructions continued, **82**, 1107.

**1882-83.** Removal of sunken trees, logs, and obstructions continued, opening the river for an additional distance of 50 miles, **83**, 866.

**1884-85.** 604 logs, snags, and stumps cleared from the channel, improving navigation over 209 miles of river, **85**, 1100.

**1886-87.** 1,564 snags, logs, and stumps, and 2,023 trees removed from the river and its banks, **87**, 1071.

**1887-88.** 634 logs, trees, and stumps removed; also 1,690 trees from the banks **88**, 922.

**1888-89.** 220 trees and stumps and 14 cords small snags removed from the channel; 50 trees and 6½ cords of brush removed from the banks, **89**, 1181.

**1889-90.** 1,517 logs, trees, and snags removed from the channel; 3,551 trees and 100 cords of brush cut from the banks, **90**, 1217.

**1890-91.** 1,080 snags removed from the channel, and 1,034 trees cleared from the banks, **91**, 1452.

**1891-92.** 1,648 snags and 10 cords of small snags removed from the channel, **92**, 1205.

**1892-93.** About 3,500 snags and other obstructions removed from the river and banks, **93**, 1475.

**1893-94.** About 1,200 snags and other obstructions removed, **94**, 1078.

**1894-95.** About 900 snags and other obstructions removed, **95**, 1402.

**1895-96.** About 100 snags and other obstructions removed, **96**, 1162.

**1896-97.** About 2,500 snags and other obstructions removed, **97**, 1449.

**1897-98.** About 4,000 snags and other obstructions removed, **98**, 1269.

**1898-99.** Over 300 snags and other obstructions removed, **99**, 1523.

**1899-1900.** About 2,500 snags and other obstructions removed, **1900**, 1849.

**Physical characteristics.**

Description, **73**, 754; H. Doc. 68, 45th Cong., 3d sess., 17, 18; **80**, 846; **99**, 1523.

List of obstructions, **73**, 755; H. Doc. 68, 45th Cong., 3d sess., 18, **80**, 846.

## GREAT PEDEE RIVER, S. C.—Continued.

Discharge, H. Doc. 68, 45th Cong., 3d sess., 19.

Original condition of the river, **88**, 920.

**Plans.** (See *Projects.*)

By W. B. Page, removal of rocks and shoals, and constructing 15 locks and dams; estimate, $1,124,301. Not recommended by Capt. Phillips. H. Doc. 68, 45th Cong., 3d sess., 17, 19, 20.

**Projects.** (See *Plans.*)

By Capt. Phillips, 1879, **79**, 723, removal of obstructions, natural and artificial, to secure a depth of 9 f. as high as Smith's Mills, 46 miles above the confluence of the Pedee and Waccamaw rivers, thence a depth of 3½ f. as high as the turn of Cheraw, 149 miles above the confluence of the two rivers, **80**, 124, 845; **91**, 1450.

From 1880 to 1886, inclusive, $47,000 was appropriated when it was estimated that $70,000 would be required to complete the project, **86**, 170; **87**, 1071.

**Surveys.**

By G. Daubeney, from Pine Bluff to Cheraw, S. C., **73**, 70, 753.

Examination, by Capt. Phillips and W. B. Page, 1878, Cheraw, S. C., to the mouth of the Uwharie, N. C., H. Doc. 68, 45th Cong., 3d sess., 16, 17; **79**, 723.

Ordered by act of Mar. 3, 1879, made 1880, under direction of Capt. Phillips, **80**, 845.

Of river, 1886, **86**, 1018.

MAPS. **89**, 1180.

## GREAT NARRAGANSETT BAY. (See *Narragansett Bay, R. I.*)

## GREAT POINT. (See *Nantucket, Mass.*)

## GREAT SALT POND, BLOCK ISLAND, R. I. (See *Block Island.*)

**Appropriations.**

1896, $40,000, **96**, 660.
1899, 50,000, **99**, 1143.

Total, 90,000.

**Commerce.**

Unimportant, **93**, 880.

**Contracts.**

**1896.** S. & E. S. Belden, jetty construction, $1.33 per t., **97**, 927.

**1900.** J. P. Randerson, dredging, 14½ and 29¾ cents per c. y. Estate of John Beattie, repairing south jetty, stone $1.40 per short t. **1900**, 1280, 1281.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 71; **96**, 54, 67; **97**, 79; **98**, 83; **99**, 95; **1900**, 109.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1892–93. Report, **93**, 880.

Lt. Col. S. M. Mansfield, 1896. Report, **96**, 620.

Maj. D. W. Lockwood, 1896–. Reports, **96**, 660; **97**, 925; **98**, 929; **99**, 1141; **1900**, 1276.

**Physical characteristics.**

Description of, **93**, 881; **96**, 621.

**Operations.**

**1896–97.** 25,701 t. stone deposited in jetty, **97**, 926.

**1897–98.** 1,200 t. stone deposited in jetty, **98**, 930.

**1898–99.** 10,756 c. y. dredged, **99**, 1143.

**1899–1900.** 79,763 c. y. dredged; 69 c. y. bowlders removed; 705 t. riprap stone placed to repair south jetty. **1900**. 1279.

**Private (State) work.**

Description of the jetties, etc., built by Rhode Island, and New Shoreham, R. I., **96**, 620.

**Projects.**

In 1896, by Lt. Col. Mansfield, extension of the south jetty 1,197 f. in length and the north jetty 500 f. in length (see *Private Work*); also for the dredging of a channel 25 f. deep and 150 f. wide, shoaling to 12 f. for 504 f. and thence to high-water line with a slope of 1 on 4; estimate, $97,567.94, **96**, 620, 660.

Secretary of War, 1899, authorized the use of available funds to secure channel 12 f. deep at harbor entrance, **99**, 1143.

Maj. Lockwood, 1899, estimated cost of completion of project would be $71,220, **1900**, 1277.

**Surveys.**

Examination of breachway into pond with a view to constructing a harbor of refuge, ordered by act of July 13, 1892, made by Capt. Bixby, 1892 (report unfavorable), **93**, 881.

Survey for harbor of refuge, ordered by act of Aug. 17, 1894, made by Lt. Col. Mansfield, 1895 (see *Projects*), **96**, 620.

By Maj. Lockwood, 1899, **1900**, 1277.

## GREAT SODUS HARBOR, N. Y.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1829, | $12,500.00, | **66**, iii, 29, 30. |
| 1830, | 15,280.00, | |
| 1831, | 17,450.00, | |
| 1832, | 17,000.00, | |
| 1833, | 15,000.00, | |
| 1834, | 15,000.00, | |
| 1835, | 11,790.00, | |
| 1836, | 12,600.00, | |
| 1837, | 12,000.00, | |
| 1838, | 10,000.00, | |
| 1844, | 5,000.00, | |
| 1852, | 10,000.00, | act Aug. 30; S. Doc. 42, 35th Cong., 1st sess., p. 139. |
| 1866, | 53,151.80, | **66**, iii, 16. |
| 1867, | 80,000.00, | **67**, 33. |
| 1870, | 5,000.00, | **70**, 53. |
| 1872, | 15,000.00, | **72**, 47. |
| 1874, | 15,000.00, | **74**, 54. |
| 1875, | 10,000.00, | **75**, 59. |
| 1876, | 5,000.00, | **76**, 111. |
| 1878, | 5,000.00, | **78**, 133. |
| 1879, | 2,000.00, | **79**, 176. |
| 1880, | 3,000.00, | **80**, 2210. |
| 1881, | 5,000.00, | **81**, 2442. |
| 1882, | 25,000.00, | **82**, 2448. |
| 1884, | 10,000.00, | **84**, 2141. |
| 1886, | 16,875.00, | **86**, 1890. |
| 1888, | 24,000.00, | **88**, 2078. |
| 1890, | 10,000.00, | **90**, 2857. |
| 1892, | 15,000.00, | **92**, 2571. |
| 1894, | 15,000.00, | **95**, 3197. |
| 1896, | 8,000.00, | **96**, 3143. |
| 1899, | 14,000.00, | **99**, 3134. |
| Total, | 489,646.80 | |

**Commerce.**

Does not warrant hasty action, **66**, iv, 171.

Importance of Great Sodus Bay commercially, S. Doc. 42, 35th Cong., 1st sess., p. 140; **66**, iv, 174–175; **79**, 1730. As a harbor of refuge, S. Doc. 42, 35th Cong., 1st sess., p. 140; **66**, iv, 174, 175; **69**, 178.

Commercial interests mainly local, **69**, 178.

98 per cent of the commerce in 1895 was 42,669 t. of coal, **96**, 3139, and the approximate value of the total commerce for that year was $169,847, **96**, 3143. In 1896 34,540 t. of coal were shipped, **97**, 3274. The total commerce in 1897 amounted to 53,548 t., **98**, 2802.

Coal chiefly, **99**, 3134.

**Contracts.**

**1866.** A. P. Grant, dredging; J. W. P. Allen, towing scows; Ontario Iron Works, materials; J. N. Collins & Co., materials; R. N. Gere, materials and labor, **66**, iv, 178.

**1867.** R. N. Gere, dredging, at 24 cents, **67**, 243. T. Parsons, dredging, 24 cents; W. Burke, dredging, 24 cents; R. R. Dodge, dredging, 24 cents; Caldwell & French, labor, **68**, 253.

**1868.** Z. Moore, removal of wreck, **68**, 250.

**1870.** C. P. Morse, removal of wreck; C. P. Morse & Co., dredging, 24 cents, **70**, 207.

**1872.** C. P. Morse & Co., repairs to breakwater; E. H. French, dredging, 35 cents, **73**, 364.

**1874.** H. J. Mowry, dredging, 22½ cents; C. J. De Graw, breakwater extension, **75**, 337.

**1875.** S. B. Robinson, repairs to breakwater, **75**, 338.

**1881.** C. F. Dunbar, dredging, 23 cents per c. y., **81**, 2443.

**1882.** G. Kellogg & Co., pier construction, **83**, 1946.

**1883.** A. J. Packard, iron, **83**, 1946.

**1884.** A. F. Chapman, pier extension, **86**, 1890.

**1886.** W. S. Malcolm, dredging, 16 cents per c. y., **87**, 2377.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 4, ii, 41, 42, iii, 16, 29; **67**, 33; **68**, 45; **69**, 40; **70**, 53; **71**, 50; **72**, 47; **73**, 47; **74**, 54; **75**, 59; **76**, 111; **77**, 118; **78**, 133; **79**, 176; **80**, 231; **81**, 318; **82**, 312; **83**, 320; **84**, 324; **85**, 349; **86**, 344; **87**, 309; **88**, 282; **89**, 334; **90**, 303; **91**, 380; **92**, 358; **93**, 411; **94**, 385; **95**, 420; **96**, 377; **97**, 475; **98**, 464; **99**, 545; **1900**, 614.

ENGINEERS IN CHARGE:

Capt. T. W. Maurice, 1828; **74**, 253.

Capt. J. L. Smith, 1836; **74**, 253.

Maj. W. Turnbull, 1853–56; S. Doc. 42, 35th Cong., 1st sess., p. 139; **74**, 254.

Maj. J. D. Graham, 1856; **66**, 4. Report, S. Doc. 42, 35th Cong., 1st sess., p. 139.

Maj. C. E. Blunt, 1866–69; **66**, ii, 41, 42. Reports, **66**, iv, 170; **67**, 238, 243, 256; **68**, 248, 250, 253.

Maj. M. D. McAlester, 1869; **69**, 170.

Capt. F. Harwood, 1869; **69**, 170.

Maj. N. Bowen, 1869–71; **69**, 170. Reports, **69**, 178; **70**, 204; **71**, 232.

Maj. J. M. Wilson, 1871–75. Reports, **72**, 256; **73**, 364; **74**, 253; **75**, 337.

Maj. W. McFarland, 1875–83. Reports, **76**, ii, 588; **77**, 980; **78**, 1275; **79**, 1729; **80**, 2209; **81**, 2441; **82**, 2446.

Lt. Col. H. M. Robert, 1883–85. Reports, **83**, 1945; **84**, 2140.

Capt. E. Maguire, 1885–87. Reports, **85**, 2274; **86**, 1890.

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[a] Survey.—Report Jan. 22, 1829, estimate $71,931.20. (H. Doc. No. 482, 55th Cong., 2d sess.)

## GREAT SODUS HARBOR, N. Y.—Continued.

Capt. C. F. Palfrey, 1887-90. Reports, **87**, 2376; **88**, 2075, 2078; **89**, 2411.

Maj. M. D. Adams, 1890-91. Report, **90**, 2855.

Capt. D. C. Kingman, 1891-95. Reports, **91**, 2906; **92**, 2564; **93**, 3140; **94**, 2464; **95**, 3192.

Maj. W. S. Stanton, 1896-98. Reports, **96**, 3139; **97**, 3274; **98**, 2801.

Capt. G. D. Fitch, 1899-. Reports, **99**, 3133; **1900**, 4166.

ASSISTANTS:

W. S. Malcolm, captain of U. S. dredge boat on Lake Ontario, 1857, S. Doc. 42, 35th Cong., 1st sess., p. 142, et seq.

Capt. J. A. Smith, 1866, **66**, iv, 170.

**Estimates.** (See *Projects.*)

Estimate, 1838, masonry superstructure, $50,000, **74**, 254.

By Maj. Bowen, dredging, $35,000; repairs, $10,000; closing the entrance between east pier and east shore, $30,000, **69**, 41, 178.

By Maj. McFarland, dredging, $15,000; annual repairs, $2,000, **79**, 1730.

**Expenditures.**

1857. Repairs to dredge and scows, $164.44, S. Doc. 42, 35th Cong., 1st sess., p. 140.

**Operations.**[a]

**1829-33.** 640 f. of west pier, 80 f. of east pier, 150 f. of jetty, and a portion of the breakwaters constructed, **74**, 253.

**1833-35.** Piers completed; 300 f. of crib protection built; dredging in harbor, **74**, 253.

**1835-38.** Dredging, **74**, 253, 254.

**1844-45.** Repairs; operations suspended, **66**, 4; **74**, 254.

**1852-53.** Repairs to east channel and harbor piers; condition of the work, S. Doc. 42, 35th Cong., 1st sess., pp. 139, 145; **74**, 254.

**1856-57.** 6,233 c. y. dredged, S. Doc. 42, 35th Cong., 1st sess., pp. 140, 144.

**1866-67.** 400 f. of west pier rebuilt; dredging; condition of work, **66**, iii, 16; **67**, 238.

**1867-68.** 440 f. of west pier rebuilt; wreck removed from channel, **68**, 45, 248.

**1868-69.** 776 f. of west pier rebuilt; dredging in the channel, **69**, 40, 178.

**1869-70.** 6,209 c. y. dredged; 130 f. added to west pier; condition of piers, **70**, 53, 204, 205.

**1870-71.** 312 f. of east breakwater rebuilt; repairs, **71**, 50, 232.

**1872-73.** 24,891 c. y. dredged; 433 f. of the east breakwater rebuilt, **73**, 47, 364.

**1873-74.** 16,808 c. y. dredged; 158 f. of the east breakwater rebuilt, **74**, 54, 254.

**1874-75.** 44,977 c. y. dredged; 353 f. of the east breakwater rebuilt; condition of work, **75**, 59, 337, 338.

**1875-77.** Repairs; sand-catcher constructed, **76**, 111, ii, 588, **77**, 118, 980.

**1877-78.** 200 f. of the west pier rebuilt; sand-catcher constructed, **78**, 133, 1275.

**1879-80.** 825 l. f. west pier superstructure rebuilt, **80**, 2209.

**1880-81.** 13,000 c. y. sand dredged, **81**, 2441.

**1881-82.** 29,000 c. y. sand dredged; 100 l. f. catch-sand fence built, **82**, 2446, 2447.

**1882-83.** Foundations for cribs and construction of same in progress; 1,245 c. y. dredged, **83**, 1945.

**1883-84.** 330 l. f. pier extension built; 1,991 c. y. dredged, **84**, 2140.

**1884-85.** 200 l. f. pier extension completed, **85**, 2275.

**1885-86.** 200 l. f. pier superstructure completed; sand fences repaired, **86**, 1890.

**1886-87.** 13,224 c. y. dredged and piers extensively repaired, **87**, 2377.

**1887-88.** Dredging by centrifugal pump; reconstruction of east pier superstructure begun by hired labor, **88**, 2076.

**1888-89.** East breakwater deck completed; repairs to scow, and to east and west piers, **89**, 2412.

**1889-90.** Renewal of west pier superstructure completed; 23,386 c. y. dredged, **90**, 2856.

**1890-91.** 500 l. f. of superstructure renewed on east pier; repairs to outer end of west pier; minor repairs to existing works, **91**, 2907.

**1891-92.** 640 l. f. of east breakwater superstructure renewed; repairs to light-house crib on west jetty; 11,219 c. y. dredged, **92**, 2570.

**1892-93.** 94,071 c. y. dredged, **93**, 3144; and 800 trees planted on the beach, west of the jetties, **93**, 3145.

**1893-94.** 16,379 c. y. dredged, **94**, 2462.

**1894-95.** 355 l. f. superstructure of west breakwater renewed and dredging plant repaired, **95**, 3196.

**1895-96.** 45,783 c. y. dredged, **96**, 3143.

**1896-97.** 48,620 c. y. dredged, **97**, 3274.

**1897-98.** 1,000 c. y. dredged, and repairs and alterations made to dredging plant, **98**, 2802.

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[a] History of work, **74**, 253; **76**, ii, 588.

## GREAT SODUS HARBOR, N. Y.—Continued.

**1898-99.** East and west piers repaired; nearly 5,000 c. y. dredged, **99**, 3133.

**1899-1900.** 3,305 c. y. dredged, repair of piers completed, and dredging plant repaired, **1900**, 4166.

**Physical characteristics.**

Bar at entrance of bay, as shown by survey of 1828, **74**, 253.

Shoaling as shown by surveys of 1844 and 1848, **74**, 254.

Formation of bar and spit of sand, **66**, iii, 16, iv, 170, **75**, 338. Cause of formation of spit, **66**, iv, 172.

Character of bed of harbor, **73**, 364.

The principal obstacle to the maintenance of the channel the sand borne into its outer end by the prevailing northwesterly winds, **97**, 3274.

**Plans.** (See *Projects.*)

For a masonry superstructure, 1838, **74**, 254.

By Maj. Bowen, renewal of all decayed superstructure, finishing east breakwater, completion of shore end of west pier, and dredging channel to 12 f., **70**, 205.

By Maj. McFarland, dredging channel to 12 f. depth, and for annual repairs to eventually replace the superstructure, **79**, 1730. Correspondence relative to the improvements, S. Doc. 42, 35th Cong., 1st sess., pp. 142-147.

**Projects.** (See *Plans*).

By Capt. T. W. Maurice, 1828, two breakwaters from the east and west shores, 1,400 and 2,200 f., respectively, in length, approaching each other, leaving an opening of about 500 f.; and parallel piers from the ends to define channel-way; estimate, $71,931.26, **76**, ii, 589. Results expected not realized, **74**, 253. 1833, for dredging a channel 1,500 f. long, 150 f. wide, and 15 f. deep; estimate $20,000, **74**, 253.

By Maj. J. D. Graham, 1857, repairs to existing piers and for dredging, estimate, $40,806, S. Doc. 42, 35th Cong., 1st sess., pages 139, 141, 176; $53,151.80, **66**, 4. Modified by Maj. Blunt to extend the west pier and dredge channel to 12 f., estimate, $80,000, in addition to Maj. Graham's estimate, **66**, iv, 171, 173, 174; **67**, 238.

After an aggregate of appropriations amounting to $351,771.80 Maj. McFarland proposed, in 1881, the extension of the east and west piers to 15-f. curve and deepening the channel to 15 f. by dredging; estimate, $100,000, **81**, 2442; **87**, 2376.

In 1889 Capt. Palfrey estimated that for maintenance of existing works, dredging the entire space between the piers to hard bottom, giving a channel 200 f. wide and 15 f. deep at extreme low water, would require, over and above prior appropriations, $54,000, **89**, 2413, 2414.

In 1891 Capt. Kingman estimated $58,000 as required for completion of the project, **91**, 2908.

By the Chief of Engineers, 1896, for modification of the project to provide that when the two piers had been extended to a total length of 539 f., the depth of 15 f. was to be obtained and maintained by dredging without further extension of the piers; the funds then available were to be applied to dredging a channel 15 f. deep and 150 f. wide between the piers, flaring to 250 f. width at the 15-f. curve; and for the maintenance of the piers and the Government dredging plant, **97**, 3274, **98**, 2801, 2802.

By Capt. Fitch, 1899, for redredging a 15-f. channel, 150 f. wide, extreme low water, flaring to 250 f. at the 15-f. curve; and for repairs to piers; estimate, $9,300. The remainder of the appropriation of 1899 intended for maintenance, **99**, 3133.

**Surveys.**

By Capt. Maurice, 1828, **74**, 253; 1844 and 1848, **74**, 254.

Examination by Capt. Smith, **66**, iv, 170. Results, **66**, iv, 174.

Under the direction of Maj. Wilson, **72**, 256; **75**, 338.

Soundings were made by Capt. Kingman in 1894, **94**, 2468.

Minor surveys, **98**, 2802, **99**, 3133.

MAPS.

Of Great Sodus Bay Harbor, **76**, ii, 588; June 30, 1879, **79**, 1730.

**81**, 2442; **94**, 2468.

## GREAT SOUTH BAY. (See *Freeport, N. Y.*)

## GREAT WICOMICO RIVER, VA.

**Commerce.**

Unimportant, **91**, 1288.

The tonnage in wood, lumber, etc., in 1893 amounted to 1,118 t., **95**, 1257. The character of the trade would not justify an improvement of the river, **95**, 1258.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 163; **91**, 146; **95**, 166.

ENGINEERS IN CHARGE:

S. T. Abert, U. S. agent. Report, **84**, 1016, 1018.

## GREAT WICOMICO RIVER, VA.—Continued.

Lt. Col. P. C. Hains, 1891. Report, **91**, 1288.

Maj. C. E. L. B. Davis, 1892–95. Report, **95**, 1256.

**Physical characteristics.**

Description of, **84**, 1017, 1018; **91**, 1288; **95**, 1257.

**Plans.**

By S. T. Abert, channel 150 f. wide and 9 f. deep from Holland Point to Seine House Point, with a turning basin at latter point; estimate, $46,419, **84**, 1019.

**Surveys.**

Ordered by act of Aug. 2, 1882; made under direction of S. T. Abert, **84**, 1018.

Examination made, 1891, under direction of Lt. Col. Hains (report unfavorable), **91**, 1288.

Examination from Cedar Point to Indian Point ordered by act of Aug. 17, 1894, made by Maj. Davis, 1894 (report unfavorable), **95**, 1256.

## GREAT WOODS HOLE. (See *Woods Hole, Mass.*)

## GREEN AND BARREN RIVERS, KY.

| Part. | Appropriations. |
|---|---|
| A.—Green River and tributaries, Ky., purchase of works and their repair | $135,000.00 |
| B.—Green River, above mouth of Big Barren River, Ky | 180,673.20 |
| C.—Green River, Rumsey, Ky., lock No. 2 | 170,000.00 |
| Total | 485,673.20 |

### Part A.—Green River and tributaries, Ky. (Purchase of improvements, and their repair.) (See *Green and Barren rivers, caring for, and operating works.*)

**Appropriations.**

1888, $135,000, **89**, 1965.

**Commerce.**

(See *Physical characteristics, Private Work.*)

**Contracts.**

**1889.** J. T. Williams & Bro., four lock houses, $12,000, **89**, 1968. Eigenham & Hollenbach, dimension stone, $8,137, **89**, 1968. M. A. Sweeney & Bro., snag-boat construction, $18,400, **89**, 1968.

**1890.** S. W. Cojlin, two dump scows, $1,293 per scow, **90**, 2258.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 195; **85**, 292; **87**, 249; **89**, 263; **90**, 237; **91**, 304; **92**, 290.

BOARD OF ENGINEERS. Report of Board of 1886 upon the commercial value and importance of the works of the Green & Barren River Navigation Co., **87**, 1903. (Majs. King, Stickney, and Mackenzie.)

ENGINEERS IN CHARGE:

Maj. W. E. Merrill. Report, **80**, 1799.

Capt. J. C. Post. Report, **85**, 1904.

Maj. D. W. Lockwood, 1888–92. Reports, **89**, 1965; **90**, 2255; **91**, 2439; **92**, 2074.

ASSISTANTS:

R. H. Fitzhugh. Report, **80**, 1802.

A. L. Duval. Report, **85**, 1910.

Lt. W. L. Sibert. Reports, **89**, 1969; **90**, 2258; **91**, 2443; **92**, 2078.

**Legislation.**

Green & Barren River Navigation Co., chartered by Kentucky, **80**, 1799.

Effort and failure to repeal act, **80**, 1801.

Acts of incorporation, **80**, 1822; **85**, 1907.

**Operations.**

**1888–89.** Repairs to buildings, etc., at locks 1 and 2 on Green River; 12,000 c. y. dredged from lock approaches; plant built at lock 3, Green River; work of removing fallen lock walls begun; construction of plant, **89**, 1969.

**1889–90.** 8 lock houses built; dredging at lock approaches; construction of new walls at lock No. 3 begun; removal of old walls at lock No. 1, Barren River, **90**, 2256.

**1890–91.** Repairs to lock, dam, guide cribs, and abutment at lock and dam No. 4, and dam No. 1; 10,000 c. y. dredged from upper and lower lock entrances at lock No. 2; repairs to lock and dam No 3; 1,035 snags cleared from the river channel, **91**, 2444, 2445.

**1891–92.** Repairs to locks and dams 1, 2, 3, 4, and 7; 28,716 c. y. dredged at lock entrances; 1,080 snags, 6,000 l. f. of old crib timber, and old cofferdam removed; 472 trees cleared from the banks, **92**, 2078, 2079.

**Physical characteristics.**

Description of ores and coals on Green River, **80**, 1808, 1810, 1812.

Distances and elevations, **80**, 1817.

**Plans.** (See *Projects.*)

By Maj. Merrill, 1 ter navigation, Green a with locks and da to $893,184, **80**.

## GREEN AND BARREN RIVERS, KY.—Continued.

## Part A. Green River and tributaries, Ky. (Purchase of improvements, and their repair.)—Continued.

virtually closing the river by its charter to the navigation company, not considered entitled to aid from government, **80**, 1801.

Report of Capt. Post on the condition of Green and Barren rivers, **85**, 1904.

Report of Board of Engineers, 1886, on the commercial value and importance of, **87**, 1903.

**Private (corporate) work.**

The Green River, under the control of a company chartered by the State of Kentucky, **80**, 1799.

Existing dams on river, **80**, 1816.

Rates of toll, **80**, 1800.

In accordance with the requirements of the act of July 5, 1885, Capt. Post reports on the condition of Green and Barren rivers, with estimated cost of relieving the same from incumbrance, so as to render them free to commerce, **85**, 1904, 1914.

Report of Board of Engineers, 1886, on the commercial value and importance of the works of the navigation company, **87**, 1903.

**Projects.** (See *Plans.*)

United States took possession of improvements on the Green and Barren rivers December 11, 1888, and the repair of locks and dams was begun. In 1888 $46,557 was thus expended, and Maj. Lockwood estimated $256,221 as required for works of repair during 1890, **89**, 263, 1965.

**Surveys.**

Survey ordered by act of March 3, 1879, **79**, 147; made, 1879, by R. H. Fitzhugh, **80**, 1802.

## Part B.—Green River, above mouth of Big Barren River, Ky.

**Appropriations.**

| | | |
|---|---|---|
| 1892, | $50,000.00, | **93**, 2609. |
| 1894, | 25,000.00, | **95**, 2474. |
| 1896, | 20,000.00, | **96**, 2272. |
| 1899, | 85,673.20, | **99**, 2583. |

Total, 180,673.20

**Commerce.**

Development of a probably valuable commerce dependent upon thorough improvement of the river, **96**, 2271.

Unimportant from Greensburg to Mammoth Cave, **1900**, 3546.

**Contracts.**

**1897.** Commercial Wood & Cement Co., cement, $10,360, **97**, 2460.

**1899.** Commercial Wood & Cement Co., Portland cement, $2.58 per barrel ($12,267.90), **99**, 2584.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 310; **93**, 329; **94**, 302; **95**, 337; **96**, 293; **97**, 370; **98**, 353; **99**, 446, 448; **1900**, 510, 512.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1891-95. Reports, **91**, 2478, 2481; **93**, 2608; **94**, 1971; **95**, 2473.

Maj. J. F. Gregory, 1896. Report, **96**, 2271.

Capt. J. G. Warren, 1897-98. Reports, **97**, 2459; **98**, 1985.

Capt. G. A. Zinn, 1899–. Reports, **99**, 2583; **1900**, 3501, 3542.

ASSISTANTS:

W. M. Hall. Reports, **97**, 2460; **98**, 1990.

G. J. Stickney. Report, **97**, 2509.

E. A. Watt. Report, **1900**, 3502.

**Legal proceedings.**

Procuring of title to land, **95**, 2474; condemnation proceedings for some land, **96**, 2271; title procured, **98**, 1986.

Negotiations in progress to purchase additional land, **1900**, 3502.

**Obstructions.**

Any improvement of the river would require reconstruction of the bridge below Canmer, **99**, 3545.

**Operations.**

**1894-95.** Site of lock and dam selected, **95**, 2474.

**1895-96.** Preparations made for beginning work, **96**, 2271.

**1896-97.** Construction of lock begun, **97**, 2459.

**1897-98.** Lock constructing continued (table showing details of work and giving unit cost, etc.), **98**, 1990.

**1898-99.** Banks protected and minor work done, **99**, 2583.

**1899-1900.** Lock completed and opened to navigation Jan. 17, 1900; all obstructions cleared from pool above lock, **1900**, 3502.

**Physical characteristics.**

Description of, pool No. 4 to Mammoth Cave, **91**, 2480.

River within limits of proposed slackwater channel wholly obstructed by snags, rocks, overhanging trees, etc., **97**, 2459.

Description of country and river, Greensburg to Mammoth Cave, **1900**, 3544.

**Projects.**

In 1891 Maj. Lockwood proposed the

## GREEN AND BARREN RIVERS, KY.—Continued.

### Part B. Green River, above mouth of Big Barren River, Ky.—Continued.

construction of two locks and dams to extend slack-water navigation from the upper limit of pool No. 4 on the river to Mammoth Cave; estimate, $361,346.40, each lock to be 36 by 161 f.; combined lift, 27 f.

Congress, 1892, authorized construction of lock and dam No. 5, **93**, 2608. Site below mouth of Bear Creek approved by Board of Engineers, **95**, 2474.

By Capt. Warren, 1897, lock and abutment of concrete instead of stone. Estimated cost of lock and dam, $180,173.18, **98**, 1986, 1988.

Capt. Zinn estimated, 1899, it would cost $27,000 for snagging operations between Mammoth Cave and Munfordville, and about $2,500 annually for maintenance, **1900**, 3546.

**Surveys.**

Examination up to Mammoth Cave ordered by act of September 19, 1890, made, 1891, under direction of Maj. Lockwood, **91**, 2481.

Examinations for location of works, **93**, 2608; **94**, 1971; **95**, 2474.

Examination of Green River, Ky., Mammoth Cave to Greensburg, ordered by act of March 3, 1899, made, 1899, by Capt. Zinn (report favorable to removing snags) (see *Projects*), **1900**, 3543.

### Part C.—Green River, Rumsey, Ky., Lock No. 2.

**Appropriations.**

| | |
|---|---|
| 1893, | $65,000, **93**, 2607. |
| 1894, | 105,000, **95**, 2471. |
| Total, | 170,000 |

**Commerce.**

Nearly all the commerce of Green River, Barren River, and Rough River consists of through shipments which pass through this lock, **96**, 2267.

**Contracts.**

**1893.** Eigenmann and Hollerbach, stone (special, $18 per c. y.; cut, $11 and $13 per c. y.; backing stone, $7 per c. y. ($25,068.78), **93**, 2607). Not completed, **94**, 1968.

J. B. Speed, cement, $1.34½ per barrel ($2,017.50), **93**, 2607.

**1895.** Evansville, Ohio & Green River Transportation Co., stone (special and coping, $11,75 per c. y.; cut, $7 and $10 per c. y.; and backing, $5 per c. y.), ($42,324.80), **95**, 2472.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 329; **94**, 302, **95**, 337; **96**, 293; **97**, 369; **98**, 352; **99**, 445, **1900**, 509.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1888-95. Reports, **93**, 2606; **94**, 1968; **95**, 2470.

Maj. J. F. Gregory, 1895. Report, **96**, 2266.

Capt. J. G. Warren, 1897-98. Reports, **97**, 2457; **98**, 1985.

Capt. G. A. Zinn, 1899-. Reports, **99**, 2581; **1900**, 3501.

ASSISTANTS:

Lt. J. J. Meyler. Reports, **94**, 1969; **95**, 2472.

G. F. Stickney. Reports, **96**, 2268; **97**, 2457.

D. A. Watt. Report, **99**, 2581.

**Operations.**

**1892-93.** Preparations made for constructing new lock, **93**, 2607.

**1893-94.** Lock constructing, **94**, 1969.

**1894-95.** Lock constructing, **95**, 2471.

**1895-96.** New lock opened in Dec., 1895, but construction continued, **96**, 2267.

**1896-97.** Lock constructing continued, **97**, 2457.

**1898-98.** Lock constructing to be continued, **98**, 1985.

**1898-99.** One lower shore crib, four upper cribs, one shore dike built, and grading completed, **99**, 2581.

**Physical characteristics.**

Material excavated from the lock site tough, fibrous, slaty rock that blasted poorly, **95**, 2471; **96**, 2267.

Lock No. 2, the second in the slack-water system of the river, **96**, 267.

**Projects.**

By Maj. Lockwood, 1893, for new lock alongside the old one, which had become dangerous, estimate $170,000, **93**, 2606; **96**, 2266.

## GREEN AND BARREN RIVERS, KY. (Locks and dams, care and operating.)

**Appropriations.**[a]

| | |
|---|---|
| 1889, | $34,189.84 |
| 1890, | 147,973.75 |
| 1891, | 150,146.42 |
| 1892, | 78,610.88 |
| 1893, | 48,968.36 |
| 1894, | 48,088.06 |
| 1895, | 42,315.42 |
| 1896, | 42,217.81 |
| 1897, | 63,090.18 |
| 1898, | 64,779.61 |
| 1899, | 48,627.20 |
| 1900, | 71,025.25 |
| Total, | 840,032.78 |

**Commerce.**

Description of; during the nine years up to 1896 in which the improvement had been in charge of the United States the average annual value of the commerce amounted to $2,328,595, **96**, 2274.

**Contracts.**

Details of expenditures. (See each annual report.)

**Engineers.**

Chief of Engineers. Reports, **93**, 330; **94**, 302; **95**, 338; **96**, 294; **97**, 370; **98**, 354; **99**, 446; **1900**, 511.

Engineers in Charge:

Maj. D. W. Lockwood, 1888–95. Reports, **93**, 2609; **94**, 1972; **95**, 2475.

Maj. J. F. Gregory, 1896. Report, **96**, 2272.

Capt. J. G. Warren, 1897–98. Reports, **97**, 2462; **98**, 1993.

Capt. G. A. Zinn, 1899–. Reports, **99**, 2584; **1900**, 3516.

Assistants:

Lt. J. J. Meyler. Reports, **93**, 2612; **94**, 1975; **95**, 2478.

G. F. Stickney. Reports, **96**, 2276; **97**, 2466.

D. A. Watt. Reports, **98**, 2000; **99**, 2595; **1900**, 3530.

**Legal proceedings.**

Leases in force for water power, etc., and collections made, **93**, 2610; **94**, 1973; **95**, 2476; **96**, 2274; **97**, 2462.

**Operations.**

**1892–93.** Locks and dams repaired; over 25,000 c. y. dredged; over 1,000 snags removed; a large quantity of other obstructions removed, and a large amount of general work done, **93**, 2613.

**1893–94.** Locks and dams repaired, and portions renewed and strengthened; about 30,000 c. y. dredged; over 1,200 snags removed; large quantities of various kinds of obstructions removed; snag boat repaired, and a great amount of general work performed, **94**, 1976.

**1894–95.** About 45,000 c. y. dredged from lock entrances and portions of Barren River where widened and deepened; locks and dams repaired; over 2,000 snags removed; large quantities of obstructions of various kinds removed, and a great amount of general work performed, **95**, 2478.

**1895–96.** Locks and dams repaired; lock No. 2 was closed and navigation through it abandoned on account of its dangerous condition; over 16,000 c. y. dredged; construction of new hull for dredge boat in progress; over 2,300 snags removed, and other obstructions removed, and much general work performed, **96**, 2276.

**1896–97.** Extensive repairs made at lock No. 1, Green River; warehouse constructed and ground graded; new hull of dredge completed and Government plant repaired; 2 barges and 4 derrick boats built; about 1,000 snags and other like obstructions removed; over 30,000 c. y. dredged, and a large amount of miscellaneous work done, **97**, 2467–2471.

**1897–98.** Reinforcement of lock No. 4, Green River, completed; portion of dam at lock No. 2 reconstructed; locks and dams repaired; Government plant repaired; over 1,200 snags and other obstructions removed, and over 6,000 trees deadened; over 30,000 c. y. dredged, and much general work performed, **98**, 2000–2005.

**1898–99.** Dredging 35,373 c. y.; rebuilding dams at lock No. 2; backing dams at lock No. 1, Barren River, and lock No. 1, Green River, and minor repairs, **99**, 2584.

**1899–1900.** Upper and lower guide cribs built at lock No. 1, Green River; placing a comb stick on dam No. 2; replacing the wooden lower gates at lock No. 3 with steel ones, and rebuilding upper gates above water; repairing and extending the crib abutment and the lock-wall paving at lock No. 4, and 14,541 snags and other obstructions removed, **1900**, 3516.

**Private work.**

Description of work done before control was acquired by the U. S., **93**, 2609; **94**, 1972; **95**, 2475; **96**, 2272.

**Physical characteristics.**

Prolonged high water in the rivers a cause for landslides and damages to completed structures, **93**, 2610; **94**, 1972; **95**, 2475; **69**, 2273.

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[a] Amount expended under the permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## GREEN BAY HARBOR, WIS. (See *Fox and Wisconsin rivers.*)

**Appropriations.**

| | | |
|---|---|---|
| 1866, | $30,500, | **66**, iii, 12. |
| 1867, | 45,000, | **67**, 21; **76**, ii, 340. |
| 1868, | 17,500 (allotted), | **68**, 24. |
| 1869, | [a]44,550 (allotted), | **69**, 22, 25; **76**, ii, 341. |
| 1870, | 17,500, | **70**, 34. |
| 1871, | 17,500, | **71**, 32. |
| 1873, | 20,000, | **73**, 32. |
| 1874, | 10,000, | **74**, 38. |
| 1875, | 10,000, | **75**, 42. |
| 1876, | 8,000, | **76**, 95. |
| 1878, | 5,000, | **78**, 113. |
| 1879, | 4,000, | **79**, 152. |
| 1880, | 6,000, | **80**, 1906. |
| 1881, | 5,000, | **81**, 2070. |
| 1882, | 20,000, | **82**, 2133. |
| 1884, | 10,000, | **84**, 1845. |
| 1886, | 7,000, | **86**, 1659. |
| 1888, | 10,000, | **88**, 1843. |
| 1890, | 10,000, | **90**, 2335. |
| 1892, | [b]25,000, | **92**, 2181. |
| 1894, | 25,000, | **95**, 2604. |
| 1896, | [b]25,000, | **96**, 2470. |
| 1897, | 5,000, | **97**, 2296. |
| 1899, | 28,600, | **99**, 2736. |
| Total, | 406,150 | |

**Commerce.**

Early commercial importance of Green Bay, **68**, 98; **76**, ii, 339.

Transportation facilities, **66**, iv, 136–138; **73**, 198.

Benefit and importance of the improvement to commerce, **66**, iii, 35, iv, 135, 136, 138; **67**, 71; **71**, 32; **72**, 116; **76**, ii, 339, 340, 344; **79**, 1487.

Description of, **1900**, 3749.

**Contracts.**

**1866.** W. S. Smith, dredging, 50 cents per c. y., **66**, iv. 133; **67**, 57.

**1868.** William Richardson, dredging, **69**, 72.

**1869.** William Richardson, dredging outfit, 30 cents per c. y., **69**, 72; Smoke & Schuette, close piling, $140 per diem, **69**, 25, 72; N. G. Dodge, dredging outfit, $120 per diem, **76**, ii, 341.

**1873.** A. Conro, dredging, 35 cents per c. y., **74**, 139; **79**, 1487.

**1874.** Green Bay Dredge & Driver Co., dredging, 24 cents per c. y., **75**, 195, 196.

**1875.** Green Bay Dredge & Driver Co., dredging, 20 cents per c. y., **75**, 197.

**1877.** Green Bay Dredge & Driver Co., repairs, **77**, 855; Green Bay Dredge & Driver Co., dredging, 12 cents per c. y., **78**, 1143.

**1878.** Green Bay Dredge & Driver Co., dredging, 22 cents per c. y., **79**, 1486, 1487.

**1880.** Green Bay Dredge & Pile Driver Co., dredging, 26 cents per c. y., **80**, 1906.

**1881.** Green Bay Dredge & Pile Driver Co., dredging, 19 cents per c. y., **81**, 2070.

**1882.** N. G. Dodge, dredging, 17 cents per c. y., **83**, 1654.

**1885.** Green Bay Dredge & Pile Driver Co., dredging, 26 cents per c. y., **85**, 1987.

**1887.** G. Denis, stone, $3.74 per cord, **87**, 2012; Shadbolt, Boyd & Co., iron, **87**, 2013; Leathem & Smith, timber, **87**, 2013.

**1890.** Green Bay Dredge & Pile Driver Co., dredging, 24½ cents per c. y., **90**, 2334; White & Finch, dredging, 18 cents per c. y., **91**, 2535.

**1892.** C. H. Starke, dredging, 14 cents per c. y. ($16,800), **93**, 2713.

**1894.** Green Bay Dredge & Pile Driver Co., dredging, 9⅞ cents per c. y. ($22,000), **95**, 2605.

**1896.** Racine Dredging Co., dredging, 6⅝ cents per c. y. ($13,250), **97**, 2659.

**1897.** A. H. Vogel, dredging, 9½ cents per c. y. ($4,750), **97**, 2659.

**1899.** E. J. Pryor, dredging, 9 cents per c. y. ($18,000), **99**, 2736.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, ii, 41, iii, 12, 35; **67**, 21; **68**, 28; **69**, 25; **70**, 34; **71**, 32; **72**, 31; **73**, 32; **74**, 37; **75**, 42; **76**, 95; **77**, 99; **78**, 113; **79**, 152; **80**, 203; **81**, 274; **82**, 270; **83**, 279; **84**, 278; **85**, 302; **86**, 296; **87**, 261; **88**, 238; **89**, 277; **90**, 250; **91**, 320; **92**, 306; **93**, 347, 359; **94**, 318; **95**, 356; **96**, 312; **97**, 395; **98**, 387; **99**, 459, 474; **1900**, 524, 538.

ENGINEERS IN CHARGE:

Col. J. D. Graham, **66**, iv, 134, 136.

Maj. J. B. Wheeler, 1866–70; **66**, ii, 41. Reports, **66**, iv, 91, 98, 133; **67**, 55, 69; **68**, 79, 98; **69**, 72.

Maj. D. C. Houston, 1870–75; **70**, 89. Reports, **70**, 92; **71**, 110; **72**, 116; **73**, 198; **74**, 139.

Maj. H. M. Robert, 1875–83. Reports, **75**, 195; **76**, ii, 338; **77**, 855; **78**, 1143; **79**, 1486; (Lt. Col.) **80**, 1905; **81**, 2069; **82**, 2133.

Capt. F. A. Hinman, 1883–84. Report, **83**, 1653.

Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1844; **85**, 1987.

Capt. C. E. L. B. Davis, 1886–92. Reports, **86**, 1658; **87**, 2012; (Maj.) **88**, 1842; **89**, 2049; **90**, 2334; **91**, 2533.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2180; **93**, 2711, 2778; **94**, 2053.

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[a] Called $45,000, **69**, 25.

[b] $5,000 of this may be expended on Fox River below Depere, Wis.

## GREEN BAY HARBOR, WIS.—Continued.

Capt. C. F. Palfrey, 1895. Report, **95**; 2603.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2469; **97**, 2657; **98**, 2295.

Capt. J. G. Warren, 1899–. Reports, **99**, 2734; **1900**, 3657, 3747, 3750.

ASSISTANTS:

Lt. J. B. Quinn. Reports, **66**, iv, 134; **67**, 69.

W. H. Hearding. Reports, **68**, 98; **74**, 139; **75**, 195.

R. S. Littlefield, **68**, 98. Report, **66**, iv, 137.

Capt. J. W. Cuyler. Reports, **72**, 116; **73**, 198.

L. Y. Schermerhorn. Reports, **78**, 1144; **81**, 2071.

Charles Crosman. Report, **78**, 1146.

**Estimates.** (See *Plans* and *Projects*.)

By Lt. Quinn, dredging, $30,500; subsequently increased to $226,187.50, **66**, iv, 135.

**Expenditures.**

**1874–75.** For repairs, $2,346.27, **76**, ii, 343.

**1876–77.** For repairs, $1,626.70, **77**, 855.

**Operations.**[a]

**1866–67.** 1,299 c. y. dredging, **66**, iv, 134. 32,294 c. y. dredging, **67**, 69, 93.

**1867–68.** 107,831 c. y. dredging; up to July 30, 1868, 123,090 c. y. had been dredged under W. S. Smith's contract, **68**, 29, 99; **76**, ii, 340.

**1868–69.** 77,822 c. y. dredging; also given as 52,762 c. y., **69**, 25; **76**, ii, 341.

**1869–70.** 105,814 c. y. dredging; revetment begun, **70**, 34, 93; **76**, ii, 341.

**1870–71.** 51,204 c. y. dredging; revetment continued, 700 f. long on each side, **71**, 32; **76**, ii, 342.

**1871–72.** 45,475 c. y. dredging, **72**, 116; **76**, ii, 342.

**1873–74.** 49,833 c. y. dredging, **74**, 139.

**1874–75.** 29,963 c. y. dredging; repairs to piers damaged by ice, **75**, 195.

**1875–76.** 34,459 c. y. dredging, **76**, 95, ii, 338.

**1876–77.** Repairs to piers damaged by ice, **77**, 99, 856.

**1877–78.** 39,283 c. y. dredging, **78**, 113, 1143.

**1878–79.** 19,335 c. y. dredging, **79**, 152.

**1879–80.** 12,571 c. y. dredged, **80**, 1905.

**1880–81.** 26,345 c. y. dredged, **81**, 2069.

**1881–82.** 18,002 c. y. dredged, **82**, 2133.

**1882–83.** 43,524 c. y. dredged, **83**, 1653.

**1883–84.** 52,211 c. y. dredged, **84**, 1844.

**1884–85.** 49,402 c. y. dredged, **85**, 1987.

**1885–86.** 11,500 c. y. dredged; 705 l. f. of east revetment and superstructure repaired, **86**, 1658.

**1886–87.** Repair of east revetment at Grassy Island, **87**, 2012.

**1887–88.** 620 l. f. of superstructure rebuilt, **88**, 1843.

**1889–90.** 6,825 c. y. dredged by hired labor, **90**, 2334.

**1890–91.** 29,737 c. y. dredged, **91**, 2534.

**1891–92.** 15,531 c. y. dredged, **92**, 2180.

**1892–93.** About 50,000 c. y. dredged, and from Fox River below Depere about 41,575 c. y. were dredged, **93**, 2712.

**1893–94.** 84,794 c. y. dredged, a small amount of refilling and riprapping done, and from Fox River 130 c. y., s. m., dredged, **94**, 2053, 2054.

**1894–95.** 48,879 c. y. dredged, **95**, 2604.

**1895–96.** 171,110 c. y. dredged, **96**, 2470.

**1896–97.** 44,610 c. y. dredged, and from Fox River 17,935 c. y. dredged, **97**, 2657.

**1897–98.** 245,216 c. y. dredged, and project for Green Bay Harbor considered as completed; from Fox River 26,384 c. y. dredged, **98**, 2295, 2296.

**1898–99.** 3,625 c. y. dredged, **99**, 2735.

**1899–1900.** 206,378 c. y. dredged, and 4,028 c. y. dredged from Fox River channel, **1900**, 3657.

**Physical characteristics.**

General, of Fox River and Green Bay, **66**, iv, 135.

Security of Green Bay Harbor, **67**, 69.

Approaches dangerous, **67**, 70.

Formation of bar at entrance to cut, **68**, 29.

Character of excavated material, **72**, 116.

Variation of water level, **72**, 31, 116; **76**, ii, 341. Results of such variation, **76**, ii, 341; **79**, 1487.

Permanence of channel once obtained, discussion of, **78**, 1144.

Table of weekly fluctuations of water surface, **81**, 2071.

Green Bay: In 1892 an ample channel existed or was in course of construction under project for Green Bay Harbor, **93**, 2778.

Formation of shoals in Fox River below Depere, **98**, 2295, **99**, 2734.

Description of: Green Bay Harbor considered to consist of that part of Green

[a] **History of operations, 76, ii, 339. Comparative costs of dredging from 1866 to 1878, 79, 1487.**

**GREEN BAY HARBOR, WIS.**—Continued.

River between Depere and the river mouth, **1900**, 3748.

**Plans.** (See *Estimates* and *Projects.*)

By Lt. Quinn, deepening the channel, by dredging, **66**, iv, 35. Amount of dredging subsequently increased from 122,500 c. y. to 411,250 c. y., as a result of the decrease in the depth of the waters of the bay, **66**, iv, 135.

By L. Y. Schermerhorn, channel, mouth of river to deep water in the bay, dredging, to give a width of 100, 170, or 200 f. the entire distance, or 200 f. part of the distance and 170 f. the remainder, **78**, 1145.

**Private work.**

American Writing Paper Co., under authority of the Secretary of War, dredged, 1900, 16,975 c. y. to connect its docks at Depere with the channel, **1900**, 3657.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Wheeler (previously recommended by Col. Graham), 1866, dredging channel from the mouth of Fox River to deep water in the bay, with a cut through Grassy Island Channel, to be 200 f. wide and 12 f. deep, and the protection of the sides of the cut through Grassy Island (from abrasion by freshets and storms) by sheet-piling; estimated cost, $155,416.77, **66**, iv, 134, 136; **68**, 28. Discussion of merits, **67**, 70. Subsequently completed by the construction of close-piling, within the original estimate, **74**, 140; **75**, 195.

By Maj. Houston, 1872, dredging cut to widen and deepen it to 14 f. throughout, 175,000 c. y., estimate, $50,000, **72**, 31, 116; **73**, 198; subsequently increased to $75,000, **74**, 38, 140; small annual appropriations necessary for the maintenance of the channel by dredging, **74**, 141; **75**, 42.

By Maj. Robert, 1876, expenditure of the appropriation of 1876 ($8,000); piling for the protection of the east pier, estimated to cost $2,650, the remainder for dredging, **76**, ii, 338. Estimated amount required for the completion of the existing project, $18,000, **79**, 152.

After an aggregate of appropriations amounting to $235,550, Maj. Robert, 1881, proposed dredging a channel 200 f. wide and 14 f. deep, revised datum, from mouth of Fox River to deep water in Green Bay, 240,000 c. y.; estimate, $72,000, **81**, 2070.

In 1892 the existing project was modified to increase the channel depth to 16 f. and to extend it to a total length of 16,500 f.; estimate, $91,915, **92**, 2181; **93**, 2711, 2712.

Act of 1892 provided $5,000 from appropriation for Green Bay to be expended at the discretion of the Secretary of War for the improvement of Fox River below Depere; a channel 150 f. wide and 13 f. deep was dredged, **93**, 2712; **96**, 2470. Act of 1896 provided an additional $5,000 in the same manner, and was used to increase the depth to 15 f., **96**, 2470.

By Capt. Zinn, 1897, modifying existing project to provide for increasing the width of the entrance at the northern end of the channel 300 f., making the total width 500 f., **97**, 2657.

In 1897, on account of the low prices for labor, etc., the estimate for completing the work was reduced from $26,915 to $2,200, **97**, 2658.

In 1897 Capt. Zinn estimated it would cost $30,000 to obtain a channel 150 f. wide and 17 f. deep in Fox River below Depere, and in 1898 reduced this estimate to $22,000, **98**, 2296.

Capt. Warren estimated, 1899, it would cost $105,600 to dredge a 20-f. channel, **1900**, 3751.

**Surveys.**

Referred to, 1853, **66**, iv, 135.

Included in Lake Survey, 1865, **66**, iv, 135.

Under the direction of Maj. Houston, **71**, 110; **72**, 116.

By W. H. Hearding, **74**, 139.

By L. Y. Schermerhorn and C. Crosman, 1877–78. Reports, **78**, 1144, 1146.

Survey made, 1881, **81**, 2069.

Survey made, 1890, under direction of Maj. Davis, **90**, 2334.

Examination of Green Bay light-house to first bridge on Fox River, ordered by of act July 13, 1892, made in the same year by Maj. Gregory (report unfavorable), **93**, 2778.

Minor surveys, **94**, 2053; **99**, 2735; **1900**, 3657.

Harbor lines established by Secretary of War, 1894, **95**, 2604.

Examination and survey for 20 f. channel from mouth of Fox River up to city of Green Bay ordered by act of March 3, 1899, made, 1899, by Capt. Warren (report favorable), **1900**, 3747.

MAPS.

Green Bay Harbor, **76**, ii, 338; **78**, 1144; **94**, 2054.

**GREEN BAY AND MISSISSIPPI CANAL.** (See *Fox and Wisconsin rivers.*)

## GREENBRIAR RIVER, W. VA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 288.

ENGINEER IN CHARGE. Lt. Col. W. P. Craighill. Reports, **77**, 709; **85**, 1866.

ASSISTANTS:

Lt. T. Turtle. Report, **77**, 709.

W. P. Smith. Report, **85**, 1867.

**Physical characteristics.**

River described, **85**, 1867.

**Surveys.**

Examination ordered by act of July 5, 1884; made, under direction of Lt. Col. Craighill (report unfavorable), **85**, 1866.

## GREEN JACKET SHOAL, R. I. (See *Providence River.*)

## GREENPORT HARBOR, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $10,000, | **83**, 528. |
| 1884, | 10,000, | **84**, 658. |
| 1886, | 5,000, | **86**, 659. |
| 1888, | 5,000, | **88**, 578. |
| 1890, | 5,000, | **90**, 661. |
| 1892, | 11,000, | **92**, 713. |
| Total, | 46,000 | |

**Commerce.**

Increased by improvement, **82**, 636.

Description of; increasing in 1894; good business done in repairing and fitting out of pleasure craft and small steamers, **95**, 871, 872.

**Contracts.**

**1883.** Luce & Hoskins, stone, $1.59 per ton, **83**, 528.

**1884.** C. H. Edwards, stone, $1.38 per ton, **85**, 664.

**1886.** J. V. Luce, stone, $1.17 per ton, **87**, 632.

**1889.** Wm. Molthrop & Co., riprap granite, $1.23 per ton, **89**, 727.

**1891.** Brown & Fleming, stone, $1.29 per ton, **91**, 813. Hartford Dredging Co., dredging, 18 cents per c. y., **91**, 813.

**1892.** P. J. Brummelkamp, dredging, 20 cents per c. y., s. m. ($9,000), **93**, 970.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 97; **82**, 97; **83**, 92; **84**, 99; **85**, 89; **86**, 90; **87**, 54; **88**, 55; **89**, 68; **90**, 61; **91**, 75; **92**, 80; **93**, 87; **94**, 78; **95**, 88, 94.

ENGINEERS IN CHARGE:

Maj. J. W. Barlow, 1881–83. Report, **82**, 635.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 527; **84**, 658; **85**, 664.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 659; **87**, 630; (Col.), **88**, 577; **89**, 725; **90**, 660; **91**, 811; **92**, 711.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 969; **94**, 692; (Col.), **95**, 829, 870.

ASSISTANT. H. N. Babcock. Report, **82**, 635.

**Operations.**

**1882–83.** 939 tons stone delivered and 45 tons placed in position, completing 25 l. f. of dike, **83**, 528.

**1883–84.** 4,047 tons stone delivered in breakwater, completing same to 805 f., **84**, 658.

**1884–85.** 6,387 tons stone placed in the work, increasing its length 428 l. f., **85**, 664.

**1886–87.** 1,596 tons stone placed in work, extending its length 92 f., **87**, 631.

**1887–88.** 13,000 tons riprap granite used in breakwater, **88**, 577.

**1888–89.** 2,410 tons riprap granite delivered in breakwater, **89**, 726.

**1889–90.** 1,011 tons riprap granite delivered in breakwater, **90**, 661.

**1890–91.** 520 tons stone placed in breakwater, **91**, 812.

**1891–92.** 12,037 c. y. dredged; 594 tons stone delivered and placed in breakwater, **92**, 712.

**1892–93.** 10,404 c. y. dredged, **93**, 969.

**1893–94.** 32,820 c. y. dredged; project completed, **94**, 692.

**Physical characteristics.**

Mean rise and fall of tide, Greenport, **82**, 636.

Description of, **88**, 577; **95**, 871.

A small anchorage ground on the southeast side of the north fork of Long Island near its eastern end, sheltered by a breakwater, **95**, 871.

**Project.**

By Maj. Barlow, in 1882, rubblestone breakwater, Joshua Point Shoal, off Joshua Point, to cover Greenport Harbor anchorage from east and northeast storms, and to prevent further shoaling of the harbor by transfer of material from point and shoal above mentioned; estimate, breakwater, extending to 18-f. curve, $46,000, **82**, 635; **87**, 630; **92**, 712.

**Surveys.**

Ordered by act of Mar. 3, 1881; made 1882, under direction of Maj. Barlow, **82**, 635.

Examination ordered by act of Aug. 17, 1894, made in that year by Lt. Col. Robert (reported favorable), **95**, 871.

Harbor lines established by the Secretary of War in 1894, **95**, 829.

MAPS. **83**, 528; **85**, 664; **93**, 970.

## GREEN RIVER, N. C. (See *Big Barren River, Ky.*)

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 164.
ENGINEER IN CHARGE. Capt. F. A. Hinman. Report, **85**, 1046.

**Physical characteristics.**
River discharge, **85**, 1046.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Capt. Hinman (report unfavorable), **85**, 1046.

## GREENWICH BAY, R. I.

**Appropriation.**
1890, $2,000, **91**, 717.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 56; **91**, 56; **92**, 60; **93**, 63.
ENGINEERS IN CHARGE:
Maj. W. R. Livermore, 1888–92. Reports, **89**, 650; **91**, 716.
Capt. W. H. Bixby, 1892–93. Reports, **92**, 623; **93**, 834.

**Operations.**
**1890–91.** 19,592 c. y. dredged, **91**, 717.
Project completed, **92**, 624.

**Physical characteristics.**
Description of, **89**, 650.

**Projects.**
By Maj. Livermore, 1888, entrance to the bay, widening the channel and giving a low-water depth of 10 f. by dredging; estimate, $2,000, **89**, 651; **91**, 717; **92**, 623.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Livermore, **89**, 650.
MAPS. **93**, 834.

## GREENWICH HARBOR, CONN.

**Appropriation.**
1896, $6,000, **96**, 725.

**Commerce.**
Description of, **95**, 862.

**Contract.**
**1896.** Hartford Dredging Co., dredging, 10.7 cents per c. y. ($3,745), **97**, 971.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **95**, 93; **96**, 82; **97**, 103; **98**, 110; **99**, 123; **1900**, 140.
ENGINEERS IN CHARGE:
Col. H. M. Robert, 1895, **95**, 860.
Maj. H. M. Adams, 1896. Report, **96**, 724.
Maj. S. S. Leach, 1897–. Reports, **97**, 970; **98**, 974; **99**, 1186; **1900**, 1350.
ASSISTANT. Lt. W. E. Craighill. Report, **95**, 861.

**Operations.**
1897–98, 35,000 c. y. dredged, **98**, 974.

**Projects.**
By Lt. Col. Robert, 1894, dredging a channel 5,000 f. long, 90 f. wide, and 9 f. deep to the lower docks and 6 f. above them, the upper end to be slightly changed to form a turning basin; estimate, $20,000, **96**, 724; **97**, 970.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made in that year under direction of Lt. Col. Robert (report favorable), **95**, 860.
A survey was made in 1896 by Maj. Leach, **97**, 970.
MAP. **98**, 974.

## GREENWICH HARBOR, GREENWICH BAY, R. I.

**Commerce.**
Description of; entirely local and small, **93**, 871.

**Engineers.**
CHIEF OF ENGINEERS. Report, **93**, 71.
ENGINEER IN CHARGE. Capt. W. H. Bixby, 1892–93. Report, **93**, 871.

**Physical characteristics.**
Description of, **93**, 871.
The harbor a cove about 2,500 y. long, 300 y. wide, and 8 f. deep along its wharf front, **93**, 871.

**Survey.**
Examination ordered by act of July 14, 1892, made by Capt. Bixby, 1893 (report unfavorable), **93**, 871.

## GROSSE POINTE. (See *Detroit River, Mich.*)

## GROSSETETE BAYOU, LA.

**Commerce.**
Description of, **97**, 1781.

**Engineers.**
Chief of Engineers. Reports, **97**, 292.
Engineer in Charge. Maj. J. B. Quinn, 1896–97. Report, **97**, 1781.
Assistant. P. H. Thomson. Report, **97**, 1782.

**Obstructions.**
Four bridges obstructed navigation, 1896, **97**, 1782.

**Physical characteristics.**
Description of; a fine stream, 80 to 100 f. wide, with an average depth of 10 f. at low tide, in 1896, **97**, 1782.

**Survey.**
Examination ordered by act of June 3, 1896, made in that year under direction of Maj. Quinn (report favorable), **97**, 1781.

## GUADALUPE RIVER, TEX.

**Commerce.**
Unimportant, **75**, 926, 927.
Description of, **95**, 1827.

**Engineers.**
Chief of Engineers. Reports, **75**, 79; **89**, 207; **95**, 266.
Engineers in Charge:
Capt. C. W. Howell, **75**, 79. Report, **75**, 924.
Maj. O. H. Ernst, 1888. Report, **89**, 1577.
Maj. A. M. Miller, 1895. Report, **95**, 1826.
Assistants:
L. M. Lynch, **75**, 924. Report, **75**, 925.
R. B. Talfor. Report, **89**, 1579.
S. M. Wilcox. Report, **95**, 1828.

**Legislation.**
State of Texas offered a bonus of eight sections of land for every mile of river cleared, **75**, 927.

**Physical characteristics.**
Description of, **75**, 925–928; **89**, 1579.
Elevations, **75**, 925.
Obstructions, **75**, 926.
Description of, mouth to Cuero: About 62 miles long, with a fall of 6 f. between Cuero and Victoria; contains about 10 shoals with many overhanging trees and other obstructions; soft bar at mouth; crossed by 5 bridges, **95**, 1826.

**Plans.**
By Capt. Howell, 1875, removal of three rafts; estimate, $7,194, **75**, 927, 928, 929.

**Surveys.**
Examination made by L. M. Lynch of river below Gonzales, **75**, 79, 924.
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Ernst (report unfavorable), **89**, 1577.
Examination from mouth to Cuero, Tex., ordered by act of Aug. 17, 1894, made, 1894, under the direction of Maj. Miller (report unfavorable) **95**, 1826.

## GULF OF MEXICO. (See *Atlantic Ocean; St. Marys River, Fla.*)

## GULF OF MEXICO (Deep-water harbor on the northwest coast).
(See *Galveston Harbor, Tex.*)

**Appropriation.**
Mar. 2, 1889 (survey), $2,000.

## GULF OF MEXICO, NORTH SHORE (Waterway).[a]

**Appropriation.**
July 4, 1832 (survey), $3,000.

## GULF OF MEXICO TO KEY WEST (Channel). (See *Key West*, etc.)

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[a] For survey for a canal between the pass of St. Andrews and river and bay of Chattahoochee, and between Pensacola Bay and Bon Secour, along the northern coast of the Gulf of Mexico. (Treas. Doc. 373, 1882.)

## GULFPORT HARBOR, MISS.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 193.

ENGINEER IN CHARGE. Maj. A. N. Damrell, 1888. Report, **89**, 1460.

**Surveys.**

Examination ordered by act of Aug. 11, 1888; made, 1889, under direction of Maj. Damrell (report unfavorable), **89**, 1460.

## GULFPORT TO SHIP ISLAND HARBOR, MISS. (Channel from).

(See *Ship Island Pass* and *Ship Island Harbor.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **98**, 269; **99**, 312; **1900**, 355.

ENGINEER IN CHARGE. Maj. W. T. Rossell, 1899–. Reports, **99**, 1722; **1900**, 2216.

**Projects.**

Congress provided, by act of Mar. 3, 1899, for a 19-f. channel, m. l. w., 300 f. wide, from the anchorage at Ship Island Harbor, on the Gulf of Mexico, to Gulfport, Miss., and an anchorage basin of similar depth, not less than 2,640 f. by 1,320 f. in area, at the end of said channel next the shore, cost not to exceed $150,000, with $10,000 annually for five years after completion for maintenance, **99**, 1722.

## GULL LAKE, MINN. (See *Mississippi River, reservoirs.*)

## GUNTERS CREEK, ALA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 288.

ENGINEER IN CHARGE. Lt. Col. J. W. Barlow, 1890. Report, **91**, 2325.

ASSISTANT. J. W. Walker. Report, **91**, 2326.

**Physical characteristics.**

Description of, **91**, 2326.

**Surveys.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Col. Barlow (report unfavorable), **91**, 2326.

## GUT. (See *Sasanoa* (*River, Me.*)

## "GUT" OPPOSITE BATH, ME. (See *Bath, Me.*)

## GUTTENBURG, IOWA. (See *Mississippi River from St. Paul to Des Moines Rapids.*)

## GUYANDOT (GUYANDOTTE) RIVER, W. VA.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1878, | $2,000, | **78**, | 108. |
| 1879, | 1,000, | **79**, | 145. |
| 1880, | 2,000, | **80**, | 1831. |
| 1881, | 3,500, | **81**, | 1987. |
| 1882, | 2,000, | **82**, | 1957. |
| 1884, | [a]2,000, | **84**, | 1754. |
| 1888, | 2,000, | **88**, | 1792. |
| 1890, | 2,000, | **90**, | 2277. |
| 1892, | 2,000, | **92**, | 2112. |
| 1894, | 2,000, | **95**, | 2509. |
| 1896, | 1,000, | **96**, | 2326. |
| 1899, | 1,000, | **99**, | 2498. |
| Total, | 22,500 | | |

**Commerce.**

Minerals, timber, and coal tributary to river, **75**, 748, 752, 753; **79**, 1348.

Description of, **95**, 2510; **96**, 2325.

Improvement effected up to 1896 by the United States had increased the commerce 100 per cent, to a total value of $11,340,000, **96**, 2325.

Timber interests of greatest value, but the rafts, etc., a constant menace to navigation, **97**, 2563.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 73; **78**, 108; **79**, 145; **80**, 196; **81**, 264; **82**, 259; **83**, 267; **84**, 266; **85**, 290; **86**, 285; **87**, 242; **88**, 228; **89**, 265; **90**, 239; **91**, 308; **92**, 294; **93**, 334; **94**, 306; **95**, 342, 343; **96**, 298; **97**, 378; **98**, 368; **99**, 432, 440; **1900**, 495, 503.

ENGINEERS IN CHARGE:

Maj. W. E. Merrill, 1874–79. Reports, **75**, 747; **79**, 1347.

Maj. J. W. Cuyler, 1880–83. Reports, **80**, 1830; **81**, 1986; **82**, 1955.

Capt J. C. Post, 1883–87. Reports, **83**, 1570; **84**, 1753; **85**, 1889; **86**, 1622.

[a] Reappropriated by act of 1886, **86**, 1622.

## GUYANDOT (GUYANDOTTE) RIVER, W. VA.—Continued.

Lt. Col. W. E. Merrill, 1887. Report, **87**, 1827.

Maj. D. W. Lockwood, 1888–95. Reports, **88**, 1791; **89**, 1986; **90**, 2276; **91**, 2469; **92**, 2111; **93**, 2639; **94**, 2004; **95**, 2508, 2517.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2324; **97**, 2562.

Maj. W. H. Bixby, 1898–99. Report, **98**, 2140.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2499; **1900**, 3343, 3396.

ASSISTANTS:

A. L. Cox. Report, **75**, 750.

J. N. Caldwell, jr. Report, **79**, 1348.

E. A. Chase. Reports, **80**, 1831; **81**, 1987.

B. F. Thomas. Reports, **90**, 2277; **91**, 2470; **92**, 2112; **93**, 2640; **95**, 2509; **96**, 2324; **97**, 2562; **98**, 2142; **99**, 2500; **1900**, 3344.

**Obstructions.**

Description of, **79**, 1348.

Two milldams, one at Pecks and the other at Lamberts, constructed under authority of circuit court, a nuisance and constant danger to the river interests, **93**, 2639; **94**, 2005; **95**, 2508; **96**, 2325; **97**, 2562; **98**, 2140; **1900**, 495.

In 1897 it was difficult to keep the lower 4 or 5 miles of the river open to steamboat traffic, because of the numerous rafts there awaiting a rise in the Ohio, **97**, 2562.

**Operations.**

**1878–79.** 110 cords of drift, 1,058 c. y. of rock filling, 2,257 c. y. of earth, and 3,378 c. f. of timber removed from dams near Barboursville. At Falls 417 c. y. of rock filling, 161 c. y. of earth, and 122 c. f. of timber removed; also 34 snags were removed from the river, **79**, 145, 1348.

**1879–80.** 800 c. y. of sand dredged; 300 c. y. solid rock removed; 3,348 snags, stumps, and trees cut and removed, **80**, 1831.

**1880–81.** 1,345 snags removed; 965 c. y. rock removed, **81**, 1987.

**1881–82.** Improvement of channel continued, **82**, 1956.

**1882–83.** 600 c. y. solid rock removed; 122 stumps and trees removed; 1,030 l. f. brush and rock dams built, **83**, 1571.

**1883–84.** 426 c. y. solid rock and 85 c. y. loose rock and gravel removed, **84**, 1753.

**1886–87.** Removal of Rogers's milldam, **87**, 1827.

**1889–90.** 1,197 c. y. solid rock, 1,209 c. y. loose rock, and 300 snags, stumps, and trees removed, **90**, 2277.

**1890–91.** Rock bar removed near Big Creek, 300 logs and a quantity of loose rock removed at mouth of Big Huff Creek, **91**, 2470.

**1891–92.** 424 c. y. solid and 4,280 c. y. loose rock, 347 snags and logs, and 7 drifts removed from the channel, **92**, 2113.

**1892–93.** About 2,300 c. y. rock and over 1,600 snags and other obstructions removed, **93**, 2640.

**1894–95.** About 3,000 c. y. rock and about 200 snags and other obstructions removed, **95**, 2510.

**1895–96.** About 3,500 l. f. bank wall built, 2,000 c. y. rock, and over 100 snags and other obstructions removed, **96**, 2326.

**1896–97.** Over 4,000 c. y. rock and about 200 snags and other obstructions removed, **97**, 2563.

**1897–98.** About 500 c. y. rock removed, **98**, 2140.

**1899–1900.** 153 snags and other obstructions and 1,367 c. y. rock removed, **1900**, 3345.

**Physical characteristics.**

Description of, **75**, 747, 748, 750, 752; **79**, 1348; **95**, 2518; **99**, 2500; **1900**, 3344, 3397.

Large mineral and timber wealth, **75**, 748, 752, 753.

Discharge, **75**, 751; **95**, 2519.

List of obstructions, **75**, 751; **79**, 1348–1351.

Table of distances and levels, **75**, 753.

Rises in the southwestern part of West Virginia and empties into Ohio River 12 miles above the mouth of Big Sandy River and 39 miles below the mouth of Great Kanawha River, **93**, 2639.

Floods previous to 1893 carried away the works constructed under authority of the State of Virginia, **93**, 2639.

**Plans.**

By Maj. Merrill, 1875, slack-water navigation, locks 160 f. by 60 f., with 10 f. lift; dams 300 f. long, with 10 f. lift; estimate, $1,420,500, **75**, 748, 749, 751, 752.

**Private (State) Work.**

Improvements by the State of Virginia by means of locks and dams (destroyed), **75**, 747.

Description of work performed under authority of the State of Virginia before the U. S. undertook improvement of the river, **93**, 2639; **94**, 2005; **95**, 2508, 2518; **96**, 2325; **1900**, 3399.

**Projects.**

By Maj. Merrill, 1878, removal of snags, rock, and other obstructions; estimate, $10,000, **75**, 794; **78**, 108; **79**, 1352; **80**, 196.

By Capt. Post, 1884, removal of snags, rock, and obstructions, mouth to Logan

**GUYANDOT (GUYANDOTTE) RIVER, W. VA.**—Continued.

Court-House, 81 miles; also purchase and removal of Roger's and Peck's milldams; estimate, $10,000, **84**, 1753; **89**, 1986; **92**, 2111.

**Surveys.**

By A. L. Cox, of river below Logan Court-House, 1874, **75**, 73, 750.

Examination of the river with a view to its improvement by means of locks and dams ordered by act of Aug. 17, 1894, made, 1894, by Maj. Lockwood (report unfavorable), **95**, 2517.

Examination of Guyandot River, from its mouth to a point 50 miles above, ordered by act of Mar. 3, 1899, made, 1899, by Capt. Hodges (report unfavorable except to snag removal), **1900**, 3393.

**HACKENSACK RIVER, N. J.**

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 93; **91**, 108.

ENGINEERS IN CHARGE:

Capt. G. McC. Derby, 1888. Report, **89**, 841.

Capt. T. L. Casey, 1888–91. Reports, **89**, 842; **91**, 1016, 1018.

ASSISTANT. C. S. Kelsey. Reports, **89**, 844; **91**, 1019.

**Physical characteristics.**

Description of, **89**, 842; **91**, 1017.

**Plans.**

By Capt. Casey, 1889, providing and maintaining a channel 10 f. deep at m. l. w., and from 200 to 150 f. wide from the mouth to Turnpike Bridge at Hackensack; estimated cost, $60,114; or, for a modified improvement, dredging a channel 8 f. deep at m. l. w. and from 200 f. wide the mouth to Turnpike Bridge; estimate $22,308, **89**, 845.

**Survey.**

Survey ordered by act of Aug. 11, 1888, made 1889, under direction of Capt. Casey (report favorable), **89**, 842; **91**, 1018.

MAPS. **89**, 844.

**HAMBURG BAY, ILL.** (See *Mississippi River.*)

**HAMILTON SLOUGH.** (See *Mississippi River.*)

**HAMMOND BAY, LAKE HURON, MICH.**

**Commerce.**

Description of, **93**, 2949.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 388.

ENGINEER IN CHARGE. Maj. W. Ludlow, 1892–93. Report, **93**, 2948.

ASSISTANT. B. H. Muehle. Report, **93**, 2949.

**Physical characteristics.**

Description of; a part of Lake Huron into which flows the Ocqueoc, a narrow stream, **93**, 2949.

**Survey.**

Examination of the bay at the mouth of the Ocqueoc River ordered by act of July 13, 1892, made, 1892, under the direction of Maj. Ludlow (report unfavorable) **93**, 2948.

**HAMPDEN CANAL, MASS.** (See *Hampshire and.*)

**HAMPSHIRE AND HAMPDEN CANAL, MASS.**[a]

**HAMPTON RIVER (CREEK) AND BAR, VA.**

**Appropriations.**

1878, $10,000, **78**, 72.
1879, 2,000, **79**, 86.
1890, 10,000, **91**, 1297.

Total, 22,000

**Commerce.**

Important, **75**, ii, 153, 155.

**Contracts.**

**1878.** Brainard & Rice, dredging, 12 cents per c. y. (contract annulled,) **79**, 618. H. E. Culpepper, dredging, 15 cents per c. y., **79**, 618.

**1891.** Atlas Dredging Co., dredgiug, 11 cents per c. y., **91**, 1298.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 95; **78**, 72; **79**, 85; **80**, 115; **89**, 120; **91**, 148; **92**, 150.

ENGINEERS IN CHARGE:

S. T. Abert, U. S. C. E., 1874–80. Reports, **75**, ii, 152; **78**, 513; **79**, 617; **80**, 779.

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[a] Examination—Report (indefinite) Jan. 22, 1830. (H. Doc. No. 482, 55th Cong., 2d sess.)

## HAMPTON RIVER (CREEK) AND BAR, VA.—Continued.

Capt. G. J. Fiebeger, 1888–92. Reports, **89**, 974; **91**, 1297.
Lt. E. Burr, 1892. Report, **92**, 1089.

ASSISTANTS:
A. K. Michler. Report, **75**, 154.
W. H. Powless, **75**, ii, 152.
T. T. George. Report, **89**, 975.

**Operations.**
**1878–79.** Dredging in progress, **79**, 618.
**1879–80.** 66,328 c. y. dredged; project completed, **80**, 780.
**1891–92.** 84,321 c. y. dredged, **92**, 1090.

**Physical characteristics.**
Description, **75**, ii, 154; **78**, 513; **89**, 976.

**Projects.**
By S. T. Abert, 1875, channel 150 f. wide by 9 f. deep through bar at mouth of river. Estimate $15,757, **75**, ii, 153; **78**, 72. Project completed in 1880, **80**, 780.

By Lt. Fiebeger, 1888, channel 200 f. wide and 9 f. deep at m. l. w. from the mouth of the creek to Hampton Bridge; also a channel of the same depth through the bar, with a width of 200 f. at the mouth of the creek and 300 f. at the turning buoy; estimate $10,000, **89**, 975.

**Surveys.**
By A. K. Michler, 1874, **75**, 95, ii, 152, 154.
Survey of bar under direction of S. T. Abert, 1878, **79**, 618.
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Fiebeger (see *Projects*), **89**, 975.

## HAMPTON RIVER, N. H.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 31.
ENGINEER IN CHARGE. Lt. Col. J. A. Smith, 1888. Report, **89**, 549.

**Physical characteristics.**
Description of, **89**, 550.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Smith (report unfavorable), **89**, 549.

## HAMPTON ROADS, VA. (Middle Ground Bar).

**Commerce.**
Description of, **1900**, 1789.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 233; **1900**, 265.
ENGINEER IN CHARGE. Maj. T. L. Casey, 1900. Reports, **1900**, 1785, 1788.

**Physical characteristics.**
Description of, **1900**, 1786.

**Projects.**
Maj. Casey estimated, 1899, it would cost $225,000 to make the desired improvement, **1900**, 1789.

**Survey.**
Examination and survey of channel at Middle Ground Bar, in harbor of Hampton Roads, Va., with view to making a 20-f. channel 500 f. wide, ordered by act of Mar. 3, 1899, made, 1899, by Maj. Casey (report favorable) (see *Projects*), **1900**, 1786, 1788.

## HANDSBORO, MISS. (Back Bay).

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 214.
ENGINEER IN CHARGE. Maj. A. N. Damrell. Report, **85**, 1373.

**Projects.**
In 1884 cost of improvement would probably exceed $140,000, **85**, 1374.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Maj. Damrell (report unfavorable), **85**, 1373.

**HANNIBAL, MO.** (See *Mississippi River from Des Moines Rapids to the mouth of the Illinois River.*)

## HARBOR LINES—ESTABLISHMENT OF.

| Place. | Reports. | |
|---|---|---|
| | Chief of Engineers. | Local officers. |
| Aberdeen, Wash | 93,462 | 93,3472 |
| Alameda Harbor, Cal. (see *San Francisco*): | | |
| Establishment of harbor lines on eastern shore of San Francisco Bay, from Point San Pablo southward, in front of Oakland and Alameda, Cal | 94,424 | 94,2505 |
| Albina, Oreg.: | | |
| Willamette River | 99,39 | 99,3251 |
| Allegheny City, Pa.: | | |
| Ohio River | 99,39 | 99,2449 |
| Anacortes, Wash | 93,462 | 93,3472 |
| Ashland Harbor, Wis | 96,23 | 96,2455 |
| Astoria Harbor, Oreg | 91,427 | 91,3387 |
| Astoria Harbor, Oreg., near | 96,23 | 96,3322 |
| Ballard, Wash | 93,462 | 93,3472 |
| Puget Sound | 95,21,473 | 95,3543 |
| Baltimore Harbor, Md.: | | |
| Curtis Bay | 90,40 | 90,1697 |
| Sparrows Point (Patapsco River) | 99,39<br>1900,40 | 99,1410<br>1900,1693,1697 |
| Bath, Me.: | | |
| Kennebec River | 91,424 | 91,622 |
| Bellingham Bay, Wash | 92,399 | 92,2794 |
| Benicia. (See *San Francisco.*) | | |
| Blaine, Wash | 93,462 | 93,3472 |
| Boston Harbor, Mass (see *Cambridge*) | 89,368<br>97,23 | 89,601<br>97,881 |
| Charles River | 90,332<br>91,424<br>99,39<br>1900,40 | 90,537<br>91,688<br>99,1098<br>1900,1225 |
| Extension of pier at Marine Park beyond established harbor lines, Dorchester Point, eastern end of South Boston | 90,332 | 90,546 |
| Mystic River, with its tributaries, and Chelsea Creek | 90,332 | 90,539 |
| North side of the "reserved channel," north side of South Boston Flats, and around Castle Island | 91,424 | 91,690 |
| Extension of solid filling beyond the established bulkhead lines at Simpson's Dry Dock No. 1, Boston Harbor | 90,332 | 90,547 |
| Bridgeport, Conn | 97,23<br>99,39<br>93,461 | 97,988<br>99,1198<br>93,998 |
| Brooklyn, N. Y. (see *New York*): | | |
| East River | 98,34 | 98,1028 |
| Brunswick, Ga | 89,367 | 89,1292 |
| Buffalo Harbor, N. Y.: | | |
| Niagara River | 95,21,472 | 95,3180 |
| Niagara River, including West Seneca | 99.39 | 99,3123 |
| Outer Harbor | 95,21,472<br>1900,40 | 95,3176,3180<br>1900,4156 |
| Calumet Harbor, Ill | 99,39 | 99,2891 |
| Cambridge, Mass. (see *Boston*) | 97,23<br>99,39<br>1900,40 | 97,881<br>99,1100<br>1900,1225 |
| Charles River | 97,23<br>1900,40 | 97,881<br>1900,1225 |
| Camden. (See *Philadelphia.*) | | |
| Charleston Harbor, S. C | 97,23 | 97,1487 |
| Ashley River | 97,23 | 97,1487 |
| Cooper River | 97,23 | 97,1487 |
| Chicago Harbor, Ill | 91,426 | 91,2661 |
| Cincinnati, Ohio | 96,23 | 96,2126 |
| Cleveland Harbor, Ohio | 95,21,472<br>96,23<br>99,39 | 95,3127<br>96,3094<br>99,3080 |
| Coronado, Cal | 90,334 | 90,2904 |
| Cosmopolis, Wash | 93,462 | 93,3472 |
| Crisfield, Md.: | | |
| Annemessex River | 99,39 | 99,1399 |
| Davenport Harbor, Iowa | 98,34 | 98,1805 |
| Detroit, Mich | 93,462 | 93,3039 |
| Detroit River, Mich | 96,23 | 96,2900 |
| Dog Island, St. Georges Sound, Fla | 1900,40 | 1900,2156 |
| Duluth Harbor, Minn | 97,23<br>1900,40 | 97,2647<br>1900,3642 |
| Duluth, Minn., St. Louis Bay, Superior Bay, and adjacent waters, Minn. and Wis | 91,426 | 91,2515 |
| Ecorse, Mich., at and near | 96,23 | 96,2900,2901, 2904 |
| Edmunds, Wash | 93,462 | 93,3472 |
| Elizabeth River, Va | 1900,40 | 1900,1791 |
| 's Island, New York Harbor (q. v.), N. Y | 96,23<br>97,23 | 96,874<br>97,1075 |

## HARBOR LINES—ESTABLISHMENT OF—Continued.

| Place. | Reports. | |
|---|---|---|
| | Chief of Engineers. | Local officers. |
| Erie Harbor, Pa | 97,24 | 97,3265 |
| Everett Harbor, Wash | 94,424 | 94,2627 |
| Fairport Harbor, Ohio | 95,21,472 | 95,3130 |
| Fall River Harbor, Mass | 1900,40 | 1900,1311 |
| Fernandina Harbor, Fla | 90,334 | 90,1545 |
| Fivemile River Harbor, Conn | 92,398 | 92,730 |
| Fort Howard, Wis | 95,21,472 | 95,2687 |
| Fort Norfolk. (See *Norfolk*.) | | |
| Fort Pulaski, Savannah, Ga.: | | |
| Savannah River in vicinity of quarantine station | 93,462 | 93,1610 |
| Fort San Jacinto. (See *Galveston*.) | | |
| Galveston Harbor, Tex | 96,23<br>98,34 | 96,1560<br>98,1571 |
| Fort San Jacinto | 1900,40 | 1900,2475 |
| Grassy Point, Minn | 95,21,472 | 95,2588 |
| Grays Harbor, Wash., at Hoquiam | 95,21,473 | 95,3547 |
| Green Bay Harbor, Wis | 95,21,472 | 95,2687 |
| Greenport Harbor, N. Y | 94,422 | 94,716 |
| Greenville, N. J | 1900,40 | 1900,1475 |
| Greenwich Harbor, Conn | 96,23 | 96,815 |
| Grosse Isle, Detroit River, Mich | 96,23 | 96,2909 |
| Grossepoint, Mich.: | | |
| Lake St. Clair | 95,21,472 | 95,3069 |
| Hancock. (See *Houghton*.) | | |
| Harlem River (see *Spuyten Duyvil*) | 94,422 | 94,786 |
| Hillsboro River, Fla. (See *Tampa, Fla.*) | | |
| Honolulu, Hawaiian Islands | 99,39<br>1900,40 | 99,3769<br>1900,5095 |
| Hoquiam, Wash. (see *Grays Harbor*) | 93,462 | 93,3472 |
| Hoquiam River | 95,21,473 | 95,3547 |
| Houghton and Hancock, Mich | 92,303<br>99,39 | 92,2165<br>99,2723 |
| Humboldt Bay, Cal | 91,427 | 91,3138 |
| Ilwaco, Wash | 93,462 | 93,3472 |
| Ironton, Minn | 95,21,472 | 95,2588 |
| James River, Va | 1900,40 | 1900,1761 |
| Jamestown, R. I.: | | |
| Conanicut Island (Narragansett Bay) | 99,39 | 99,1146 |
| Jersey Flats, west side of Upper Bay, New York Harbor, extending from mouth of Hudson River at Jersey City to Constable Point, Bergen Neck, N. J | 91,425<br>1900,40 | 91,965<br>1900,1475 |
| Kansas City, Kans., and Kansas City, Mo.: | | |
| Missouri River | 94,423 | 94,3159 |
| Kenosha Harbor, Wis | 96,23<br>1900,40 | 96,2568<br>1900,3776 |
| Kewaunee Harbor, Wis | 97,24 | 97,2785 |
| Laconner, Wash | 93,462 | 93,3472 |
| Laporte, Tex | 1900,40 | 1900,2476 |
| Licking River, Ky., at its mouth | 96,23 | 96,2126 |
| Long Island City: | | |
| East River, N. Y | 98,34 | 98,1025 |
| Lubec, Me | 91,424 | 91,621 |
| Manitowoc Harbor, Wis | 96,23 | 96,2565 |
| Marine City, Mich | 96,23 | 96,2747 |
| Marquette, Mich | 39,366 | 89,2027 |
| Martinez. (See *San Francisco*.) | | |
| Marysville, Wash | 93,462 | 93,3475 |
| Milford Harbor, Conn | 95,21,471 | 95,893 |
| Milwaukee, Wis.: | | |
| Milwaukee River | 93,462 | 93,2788 |
| Between Cherry and Walnut streets | 95,21,472 | 95,2686 |
| Mount Hope Bay, Mass | 1900,40 | 1900,1311 |
| Napa, Cal.: | | |
| Napa River | 94,424 | 94,2522 |
| Neuse River, N. C | 1900,40 | 1900,1837 |
| New Astoria, Oreg | 96,23 | 96,3320 |
| Newbern Harbor, N. C | 1900,40 | 1900,1837 |
| Newcastle, Del | 91,425 | 91,1225 |
| New Haven Harbor, Conn | 95, 21, 471<br>1900, 40 | 95,882<br>1900,1366 |
| New London Harbor, Conn. (see *Shaws Cove*) | 99, 39<br>1900, 40 | 99,1189<br>1900,1363 |
| New York City, N. Y.: | | |
| East River | 97,23 | 97,1061 |
| Between Bungay and Cabot streets, Oak Point | 99,39<br>1900,40 | 99,1255<br>1900,1455,1457 |
| West Side of Rikers Island | 99,39 | 99,1254 |
| Between East Twenty-third and East Twenty-fourth streets | 99,39 | 99,1258 |
| Harlem River | 94,422 | 94,786 |
| At its entrance into East River | 96,23 | 96,870 |
| Hudson River | 97,23 | 97,1067,1070 |

## HARBOR LINES—ESTABLISHMENT OF—Continued.

| Place. | Reports. | |
|---|---|---|
| | Chief of Engineers. | Local officers. |
| New York Harbor, N. Y | 89,368<br>1900,40<br>97,723 | 89,807<br>1900,1455,1457, 1475<br>97,1070 |
| Harlem River | 96,23 | 96,870 |
| Ellis Island (q. v.) | 96,23 | 96,874 |
| Near foot East Eighty-ninth street | 97,23 | 97,1081 |
| West Twenty-third street to West Eighty-first street | 97,23 | 97,1067 |
| Mod. on Harlem River and Spuyten Duyvil Creek | 97,23 | 97,1077 |
| Mod. on Ellis Island | 97,23 | 97,1075 |
| New York Harbor and adjacent waters (see *Brooklyn; Ellis Island; Harlem River; Long Island City; Raritan Bridge; Rikers Island; Spuyten Duyvil Creek*): | | |
| Kill van Kull and Shooters Island | 90,332 | 90,786 |
| East shore of East River, N. Y., from foot of Broadway, Brooklyn, to Ravenswood, L. I | 90,332 | 90,791 |
| Shore of New Jersey from Communipaw, Jersey City, to Constable Point, Bergen Neck | 90,332 | 90,794 |
| South and west shores of Staten Island from Fort Wadsworth to Elizabeth Point, N. J., and west bank of Arthur Kill from Perth Amboy to Elizabeth Point, N. J | 90,332 | 90,796 |
| East shore of East River, N. Y., Buttermilk Channel, and both shores of Gowanus Bay from Lawrence Point to Fort Hamilton | 90,333 | 90,810 |
| West bank of Hudson River along Jersey City front from Weehawken Cove to Communipaw Ferry | 90,333 | 90,816 |
| East, north, and west shores of Newark Bay, N. J | 90,333 | 90,818 |
| West bank of North River from Weehawken Cove to Guttenberg, N. J.; east bank of North River from West Eightieth street to the Battery, New York City; the Battery; and north and west shores of East River from the Battery to East Eighty-first street, New York City | 90,333 | 90,820 |
| Raritan Bay and River, N. J.; north shore from Perth Amboy to Crab Island, and south shore from Crab Island around South Amboy to Cheesequakes Creek | 90,333 | 90,826 |
| Ellis Island, N. J | 90,333 | 90,829 |
| Pierhead line for west half of south shore of Staten Island from Sequines Point to Wards Point | 90,333 | 90,831 |
| Modification of pierhead line on east shore of East River from First street, Brooklyn, to bridge across Bushwick Creek at Kent avenue | 90,333 | 90,833 |
| East side of Manhattan Island from East Eighty-first street north to Third avenue bridge; west side of Manhattan Island from West Eighty-first street north to Spuyten Duyvil Creek; west bank of North River from Guttenberg, N. J., north to Bloomer, N. J.; Spuyten Duyvil Creek through the Harlem River to Third avenue bridge; north shore of Bronx Kills from Third avenue bridge eastward to Bungay street (Port Morris); and Blackwell, Ward, Randall, and Sunken Meadow islands | 91,424 | 91,958 |
| Raritan River from Crab Island to head of navigation at New Brunswick, N. J | 91,424 | 91,960 |
| Newtown Creek, N. Y., between terminals at Whale Creek and Dutch Kills established by the Secretary of War Feb. 8, 1890, and Metropolitan avenue (the present head of navigation of the creek) | 91,424 | 91,961 |
| East River, N. Y., along the north shore from Port Morris eastward to Throg Neck, including entrance to Bronx River and Westchester Creek; along the south shore from Lawrence Point eastward to Willetts Point, including Bowery and Flushing Bay, and around North Brother, South Brother, Berrien, and Rikers islands | 91,425 | 91,963 |
| Modification of pier and bulkhead line on the north shore of Staten Island, between John street and Houseman avenue, produced | 91,425 | 91,978 |
| Great Mill and Little Mill rocks, East River | 92,398 | 92,849 |
| Eastern shore of Gravesend Bay from Fort Hamilton to Coney Island | 92,398 | 92,850 |
| Southern shore of Raritan and Sandy Hook bays from Chesapeake Creek to the highway bridge across Shrewsbury River at Navesink Highlands | 92,398 | 92,851 |
| Modification of harbor lines in Jersey flats, in front of Bayonne, N. J., to permit solid fitting and construction by R. G. Packard outside the established harbor lines | 92,398 | 92,854 |
| Modification of harbor lines established January 9, 1891 (91, 963), on the north shore of East River, between Oak Point and Hunts Point | 92,396 | 92,859 |
| Modification of pierhead line established March 4, 1890 (90, 1892), on the Arthur Kill, in front of Perth Amboy, N. J | 92,398 | 92,862 |
| Modification of harbor lines around Rikers Island, East River, N. Y. | 93,461 | 93,1085 |
| Modification of harbor lines on east shore of East River at Ravenswood, Long Island, N. Y | 93,461 | 93,1090 |

## **HARBOR LINES—ESTABLISHMENT OF**—Continued.

| Place. | Reports. | |
|---|---|---|
| | Chief of Engineers. | Local officers. |
| Niagara River, N. Y | 1900,40 | 1900,4156,4159 |
| Norfolk and Portsmouth harbors | 89,366 | 89,977 |
| Norfolk and Portsmouth harbors, Va., and adjacent waters: | | |
| Eastern, southern, and western branches of Elizabeth River; Elizabeth River below western branch, and bulkhead lines in Norfolk Harbor from Norfolk & Western Railroad bridge and U. S. navy-yard to Lamberts Point | 90,334 | 90,1032 |
| Southern branch of Elizabeth River and Elizabeth River below Fort Norfolk | 90,333 | 90,1030 |
| Norfolk Navy-Yard, Va | 92,399 | 92,1097 |
| North Tonawanda, N. Y | 1900,40 | 1900,4159 |
| Norwalk Harbor, Conn | 99,39 | 99,1202 |
| Oakland Harbor, Cal. (see *San Francisco*) | 94,424 | 94,2505,2506 |
| Oconto Harbor, Wis | 93,462<br>94,424 | 93,2784<br>94,2124 |
| Ocosta, Wash | 93,462 | 93,3472 |
| Ohio River, Ohio | 94,423 | 94,1894 |
| Olympia, Wash | 92,399<br>96,23<br>97,24 | 92,2794<br>96,3391<br>97,3484 |
| Oshkosh: | | |
| Fox River, Wis | 99,39 | 99,2819 |
| Oswego, N. Y | 93,462 | 93,3178 |
| Patchogue River | 94,422 | 94,719 |
| Philadelphia, Pa.: | | |
| East shore of Delaware River, from Kaighn Point to Cooper Point, along the water front of Camden, N. J | 91,425 | 91,1121 |
| West shore of Delaware River, from Moore to Otis streets, along the water front of Philadelphia, Pa | 91,425 | 91,1125 |
| Delaware River | ............<br>............<br>............<br>............<br>............<br>94,423 | 73,887<br>74,ii,145,146<br>77,270<br>78,431,443<br>79,462<br>94,864 |
| Pittsburg and Davis Island Dam, Pa.: | | |
| Ohio River | 95,21,471 | 95,2420 |
| Pittsburg Harbor, Pa | 95.21,471 | 95,2420 |
| Allegheny River | 96,23 | 96,2219 |
| Monongahela River | 95,21,471<br>96,23 | 95,2420<br>96,2215 |
| Portage Lake, Mich | 89,274<br>90,246<br>91,316,317,<br>426 | 89,2027<br>90,2323<br>91,2519 |
| Port Angeles, Wash | 93,462 | 93,2472 |
| Port Costa. (See *San Francisco.*) | | |
| Port Huron Mich. (see *St. Clair*): | | |
| Black River | 93,462 | 93,2958 |
| Portland, Oreg | 92,399<br>1900,40 | 92,2869<br>1900,4456 |
| Port Townsend, Wash | 93,462 | 93,3472 |
| Portsmouth. (See *Norfolk.*) | | |
| Puget Sound, Wash | 95,21,473 | 91,3543 |
| Quincy Bay, Ill | 90,334 | 90,2010 |
| Raritan Bridge and Marshy Point: | | |
| Raritan River, N. J | 96,23 | 96,819 |
| Richmond to City Point, Va.: | | |
| James River | 90,333<br>1900,40 | 90,1012<br>1900,1761 |
| Rikers Island, N. Y. (see *New York City, etc.*): | | |
| East River | 95,21,471 | 95,1017 |
| Rockland Harbor, Me | 95,21,471<br>1900,40 | 95,595<br>1900,1138 |
| Sabine Pass, Tex.: | | |
| Harbor | 96,23 | 96,1521 |
| Sailors Encampment Island, Mich.: | | |
| St. Marys River | 96,23 | 96,2897 |
| St. Augustine Harbor, Fla | 91,425 | 91,1685 |
| St. Clair Lake, Mich | 95,21,472 | 95,3069 |
| Port Huron | 98,34 | 98,2607 |
| St. Georges Sound, Fla | 1900,40 | 1900,2158 |
| St. Joseph Harbor, Mich | 94,424<br>98,34 | 94,2258 |
| St. Louis Bay and around Grassy Point, Minn. and Wis | 95,21,472 | 95,2588 |
| San Diego Harbor and adjacent waters, Cal | 90,334<br>92,399 | 90,2904<br>92,2640 |
| Sandusky Harbor, Ohio | 98,34 | 98,2733 |
| San Francisco Bay, Cal.: | | |
| Eastern shore of San Francisco Bay, from Point San Pablo southward in front of Oakland and Alameda | 94,424 | 94,2505,2506 |
| Between San Pablo and Oakland | 99,39 | 99,3194 |

## **HARBOR LINES—ESTABLISHMENT OF**—Continued.

| Place. | Reports. | |
|---|---|---|
| | Chief of Engineers. | Local officers. |
| San Francisco Harbor and adjacent waters | 91,426 | 91,2948 |
| Water front of the City of San Francisco and at Mission Rock, bay of San Francisco | 90,334 | 90,2890 |
| Port Costa and Martinez on the south shore of Carquinez Strait, and Benicia on the north shore and east shore of Mare Island Strait | 90,334 | 90,2893 |
| San Jacinto Bay, Tex | 1900,40 | 1900,2476 |
| San Pablo. (See *San Francisco.*) | | |
| San Pedro, Wilmington Harbor (q. v.), Cal | 91,426<br>92,399 | 91,2976<br>92,2638 |
| Sault Ste. Marie, Mich.: | | |
| St. Marys River | 93,462 | 93,3037 |
| Savannah, Ga. (see *Fort Pulaski*) | 98,34<br>89,367 | 89,1285 |
| Seabright, N. J.: | | |
| Shrewsbury River | 94,423 | 94,823 |
| Seattle, Wash | 93,462<br>95,21,473<br>99,39 | 93,3472<br>95,3543 |
| Shaws Cove, New London Harbor (q. v.), Conn | 93,461 | 93,997 |
| Shelton, Wash | 93,462 | 93,3475 |
| Sidney, Wash | 93,462 | 93,3472 |
| Snohomish, Wash | 93,462 | 93,3475 |
| Snow Hill, Md.: | | |
| Pocomoke River | 96,23 | 96,994 |
| South Bend, Wash | 93,462 | 93,3472 |
| Southern Branch, Va.: | | |
| Elizabeth River | 96,23 | 96,1094 |
| Spuyten Duyvil Creek (see *Harlem River*), N. Y | 97,23 | 97,1077 |
| Squaws Island, N. Y.: | | |
| Niagara River | 94,424 | 94,2452 |
| Stamford Harbor, Conn | 90,332<br>1900,40 | 90,682<br>1900,1368 |
| Steilacoom, Wash | 93,462 | 93,3472 |
| Superior Bay, Minn. and Wis | 94,423<br>97,23 | 94,2039<br>97,2647 |
| Superior, Wis.: | | |
| Allouez Bay | 93,462 | 93,2695 |
| Superior Harbor, Wis | 1900,40 | 1900,3642 |
| Tacoma, Wash | 93,462<br>99,39 | 93,3472 |
| Tampa, Fla.: | | |
| Hillsboro River | 99,39<br>1900,40 | 99,1643<br>1900,2084 |
| Thames River, Conn | 1900,40 | 1900,1363 |
| Trent River, N. C | 1900,40 | 1900,1837 |
| Toledo, Ohio: | | |
| Maumee River | 96,23<br>99,39 | 96,3091<br>99,3078 |
| Troy to New Baltimore: | | |
| Hudson River | 90,332 | 90,770 |
| Vancouver, Wash | 92,399 | 92,2794 |
| Washington, D. C.: | | |
| Anacostia River | 92,398 | 92,1079 |
| Potomac River | 99,39 | 99,1463 |
| Waukegan Harbor, Ill | 97,24 | 97,2786 |
| Westchester, N. Y.: | | |
| From estuary at East River | 94,423 | 94,790 |
| West Seneca. (See *Buffalo.*) | | |
| Willamette River, Oreg | 1900,40 | 1900,4456 |
| Wilmington, N. C | 96,23 | 96,1147 |
| Wilmington Harbor, Cal. (see *San Pedro*) | 95,21,473 | 95,3287 |
| Yonkers, N. Y.: | | |
| Hudson River | 98,34 | 98,1072 |
| Youngs Bay, Oreg., near Astoria | 96,23 | 96,3322 |
| Youngs Bay, Flavel, Oreg.: | | |
| Columbia River | 93,463 | 93,3537 |

## HARLEM KILL. (See *New York Harbor, N. Y.*)

## HARLEM RIVER, N. Y. (See *New York Harbor, N. Y.*)

**Appropriations.**[a]

| | | |
|---|---|---|
| 1875, | $10,000, | **75**, i, 102, ii, 220; **77**, 248. |
| 1878, | [b]300,000, | **78**, 55, 419. |
| 1879, | [b]100,000, | **79**, 62, 385. |
| 1888, | 70,000, | **88**, 601. |
| 1890, | 250,000, | **90**, 712. |
| 1892, | 175,000, | **92**, 786. |
| 1894, | 125,000, | **95**, 927. |
| 1896, | 125,000, | **96**, 850. |
| 1899, | 100,000, | **99**, 1234. |
| Total, | 1,255,000 | |

**Contracts.**

**1888.** J. Satterlee, excavation above and below mean low water, 93 cents and $1.13 per c. y., respectively, **88**, 602. E. L. Richardson, timber, **88**, 602. J. Temines, drift bolts, **88**, 602.

**1889.** J. Satterlee, dredging, 40 cents per c. y., **89**, 772.

**1891.** L. McCallum, dredging, 28 and 38 cents per c. y.; crib and revetment work ($123,546). P. S. Ross, dredging, 30 and 40 cents per c. y.; crib and revetment work ($122,478), **91**, 896, 897; **93**, 1030.

**1893.** Open-market agreements, revetment work, **93**, 1031; Morris & Cumings, dredging, 19, 22½, 28, and 30 cents per c. y.; rock removal, $4.98 per c. y.; crib work, etc.; stone for crib and revetment work, 47½ and 49½ cents per c. y. ($125,334.50), **94**, 749; **95**, 845.

**1894.** R. R. Moore, dredging, 18 and 20 cents per c. y.; revetment work ($72,770), **95**, 927.

**1896.** R. R. Moore, dredging, 14½ and 20 cents per c. y.; revetment work ($80,022.50), **97**, 1023.

**1897.** U. Maurer Sons, stone retaining wall ($3,090), **98**, 1034.

**1899.** J. P. Conkling, purchase and removal of 235,000 c. y., more or less, broken stone, owned by the United States, at 22 cents per c. y. (annulled), **99**, 1233; **1900**, 1407. P. Sanford Ross, Inc., dredging, 10.4 cents per c. y., s. m. ($15,600), **1900**, 1409.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 86; **74**, 95, 96; **75**, 101, 103; **76**, 55; **77**, 50; **78**, 55; **79**, 62; **80**, 82; **81**, 100, 108; **82**, 101; **83**, 96; **84**, 103; **85**, 93; **86**, 94; **87**, 58; **88**, 59; **89**, 74; **90**, 65; **91**, 84; **92**, 88; **93**, 95; **94**, 86; **95**, 98; **96**, 105; **97**, 110; **98**, 124; **99**, 135; **1900**, 153.

ENGINEERS IN CHARGE:

Lt. Col. J. Newton, 1874–84. Reports, **74**, ii, 165, 169; **75**, ii, 202, 219, 224; **76**, 224, 246; **78**, 414; **79**, 385; (Col.), **80**, 507; **81**, 631; **82**, 656; **83**, 543.

Capt. J. Mercur, 1877, in temporary charge; 1884–85. Reports, **77**, 248; **84**, 704.

Lt. Col. W. McFarland, 1885–89. Reports, **85**, 674; **86**, 672; **87**, 665; **88**, 598.

Lt. Col. G. L. Gillespie, 1889–96. Reports, **89**, 767; **90**, 705; **91**, 886; **92**, 778; **93**, 1025; **94**, 741, **95**, 917; (Col.), **96**, 840.

Lt. Col. W. Ludlow, 1897. Report, **97**, 1019.

Maj. H. M. Adams, 1898. Report, **98**, 1031.

Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1232.

Maj. E. H. Ruffner, 1900. Report, **1900**, 1406.

ASSISTANTS:

J. H. Striedinger, **74**, ii, 173; **75**, ii, 236. Report, **76**, 244.

A. Doerflinger. Report on storage of unused stone of 1887, **99**, 1238.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Col. Newton, 1874, removing bridge piers, and rock to depth of 12 f. from Harlem River, near East River, $167,875.56, **74**, ii, 173; **75**, ii, 220; **76**, 245; **77**, 248. Channels from Randalls Island, by way of Spuyten Duyvil Creek to the Hudson River, 12 f. by 350 f., $2,270,825.18; 15 f. by 350 f., $2,777,571.44, **75**, ii, 237. Cut through Dykeman's Meadows, $1,963,000; through Spuyten Duyvil, by way of King's bridge, $3,321,000, **76**, 246.

**Legal proceedings.**

Rules and regulations for operation of all the bridges crossing the Harlem River prescribed by Secretary of War on May 14, 1898 (see *Obstructions*), **98**, 1035.

Owners of land near Spuyten Duyvil, occupied by stored stone, commenced proceedings, 1899, to dispossess the U. S. from occupancy of the land (see *Contracts*), **1900**, 1407.

**Legislation.**

Delay in securing right of way, **80**, 507; **86**, 674; **87**, 668.

Acts of State of New York relating to right of way, **87**, 677.

The department of public works, New York, in 1892, adopted a resolution

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[a] $10,000 allotted, 1874, from appropriation for East and Harlem rivers near Hell Gate, **74**, ii, 165; **77**, 248.

[b] A proviso attached to each of these appropriations, rendering them unavailable until the right of way is secured to the United States free of cost, **78**, 55; **79**, 385. Secured, 1887, **87**, 671, 674.

## HARLEM RIVER, N. Y.—Continued.

closing the bridges across the river at Madison and Third avenues between 6 and 10 in the forenoon and 4 and 7 in the afternoon, the periods of greatest daily traffic between the two shores, **93**, 1028.

New York State acts for construction of bridges across the streams improved under title of Harlem River at 125th street, **95**, 928; at 145th street, **96**, 851; at junction of Harlem River with Spuyten Duyvil Creek, **96**, 853.

**Obstructions.** (See *Legal proceedings; Legislation.*)

Bridges in Harlem River, **91**, 889; **92**, 780.

List of bridges crossing the river, **93**, 1028; **94**, 744; **95**, 920; **96**, 842; **97**, 1024; **98**, 1035; **99**, 1236.

List of bridges affected by State acts or by notices served by Secretary of War, **93**, 1028; **94**, 744; **95**, 921; **96**, 843; **97**, 1025.

**Operations.**

**1874–75.** Piers and abutments of the old bridge, opposite 114th street, removed by dredging, 1,260 c. y., **75**, ii, 202.

**1875–76.** Removal of 1,003 c. y. of rock from reef abreast of 125th street, **76**, 55, 244, 245.

**1886–87.** Right of way obtained May, 1887, **87**, 58, 674.

**1887–88.** 43,488 c. y. dredged, **88**, 600. Experimental crib constructed, **88**, 601.

**1888–89.** 152,973 c. y. dredged; 99 f. crib work built, and 1,929 c. y. stone filling placed, **89**, 769, 770.

**1889–90.** 264,512 c. y. dredged, **90**, 707.

**1890–91.** 116,076 c. y. dredged and 2,487 c. y. rock excavated from the channel, **91**, 891.

**1891–92.** 40,063 c. y. rock excavated and 241,730 c. y. dredged from the channel; 1,152 c. y. dry stone wall and 2,095 c. y. wall laid in mortar built; 100 l. f. of crib-work revetment and 90 f. of pile-work revetment built, **92**, 784.

**1892–93.** 26,216 c. y. earth and rock excavated and removed; 384,276 c. y. dredged; 404 c. y. dry stone wall and 406 c. y. wall laid in mortar built, and 200 t. large bowlders removed, **93**, 1032, 1033.

**1893–94.** 4,380 c. y. rock excavated and removed; 155,520 c. y. dredged; 359 l. f. crib work and 229 l. f. pile work constructed; wreck of canal barge removed, and 1,300 c. y. rock removed from Candle Factory Reef, **94**, 746, 747.

**1894–95.** 174 c. y. rock excavated; about 230,000 c. y. dredged; 384 l. f. timber revetment and 200 l. f. pile work constructed, and over 4,000 c. y. rock removed from Candle Factory Reef, **95**, 924, 925.

**1895–96.** 317 c. y. rock excavated; about 242,000 c. y. dredged; over 500 l. f. crib work completed; 6,136 tons stone removed from piers of old bridge which formerly spanned the river near 114th street, and some bowlders removed, **96**, 845–847.

**1896–97.** 413,000 c. y. dredged and 1,552 t. rock removed from entrance to Mott Haven Canal, **97**, 1021.

**1897–98.** 320,688 c. y. dredged; 741 l. f. revetment work constructed; 1,602 t. rock removed from various parts of the river, and 41 l. f. stone retaining wall built, **98**, 1032, 1033.

**1898–99.** Repairs to plant and 396 c. y. stone removed from stone pile by contractor, **99**, 1233.

**1899–1900.** 11,097 c. y. stone removed from stone pile and 132,174 c. y. dredged from mouth of Spuyten Duyvil Creek, **1900**, 1407, 1408.

**Physical characteristics.**

Of Harlem River, near East River, **74**, ii, 169, 170; near Spuyten Duyvil Creek, **75**, ii, 224, 227, 228, 232–235; **76**, 246, 247.

Description of the river, **88**, 598; **92**, 784, 785.

Water higher in 1893 than ever before noticed. Works for improvement of river damaged, **93**, 1031.

Character of river bed in vicinity of Candle Factory Reef, **95**, 924, 925.

Tidal observations to determine tidal changes following the opening of the new cut along Dyckman Creek, **96**, 847, 848.

**Plans.** (See *Estimates* and *Projects.*)

By Comptroller Green, of New York, for bulkheads on both sides of the channel, backed with dredged material, **75**, ii, 227, 228.

By Lt. Col. Newton, channels 12 f. by 350 f., and 15 f. by 350 f. from Randalls Island, via Harlem River and Spuyten Duyvil Creek, to the Hudson River, **75**, ii, 235–237; **76**, 246.

By Col. Newton, 1882, channel through Harlem Kills 300 f. wide and 3,400 f. long. Estimate, 18 f. depth, $3,488,400; 15 f. depth, $2,204,409; 12 f. depth, $1,161,225, **82**, 657.

By Col. Newton, 1884, channel 350 f. wide and 15 f. deep from the Hudson to Harlem River at Morris Dock, opposite Shermans Creek. Estimate (1) via Dyckmans Creek, $2,091,684; (2) via Kings Bridge, $3,038,698; (3) via Shermans Creek, $3,026,078, **84**, 705.

**Private (city) work.**

The city of New York expended $3,900 in 1858 in removing old bridge piers be-

## HARLEM RIVER, N. Y.—Continued.

tween 114th street and Wards Island, **74**, ii, 171, 172.

**Projects.**

By Lt. Col. Newton, removing old bridge piers, drilling, blasting, and dredging rock at various places near East River; estimate $167,875.56, **74**, ii, 165, 172, 173; **76**, 245.

By Col. Newton, 1875, channel 15 f. deep at mean low water from Randalls Island, by way of Spuyten Duyvil Creek, to the Hudson River, including the removal of rock obstructions around piers of High Bridge, excavation of canal prism, dredging, and revetment, the width of channel to be 400 f., except through Dyckmans Meadow, where it is reduced to 350 f.; estimate $2,100,000, **75**, ii, 236, 237; **84**, 705; **85**, 676. Improvement of Harlem River between this proposed channel and its mouth, $600,000, **75**, ii, 237; **85**, 676. Aggregate estimated cost of entire improvement, $2,700,000, **75**, ii, 237; **85**, 676; **86**, 674; **87**, 668.

History of project, **87**, 666.

By Lt. Col. Gillespie, 1893, removing Candle Factory Reef, **94**, 747; and other rocky obstructions in the lower river, by hired labor and use of Government plant, **95**, 923.

By Lt. Col. Ludlow, 1897, expending appropriation of 1896 in continuation of work of improvement by contract and hired labor, **97**, 1021.

Chief of Engineers recommended, 1899, that the land on which the unused stone of 1887 was stored be purchased or that the stone be dumped into the Harlem River, **99**, 1238.

**Surveys.**

Under direction of Lt. Col. Newton, by J. H. Striedinger, C. De Foresta, and V. M. Newton, 1873. Report, **74**, ii, 169.

Under direction of Lt. Col. Newton, by J. H. Striedinger, De Foresta, Doerflinger, Geiseler, and Preuss, 1874, **75**, ii, 236. Reports, **75**, ii, 224; **76**, 246.

Under direction of Lt. Col. Newton, 1878–79, **79**, 62, 385.

Ordered by act of Mar. 3, 1881, made, 1881, under direction of Col. Newton, **82**, 656.

Miscellaneous surveys, **93**, 1033.

Harbor lines of the river and Spuyten Duyvil Creek modified in 1893, **94**, 743, and in 1897, **98**, 1032.

Maps. **82**, 656.

**HARLOWE RIVER, N. C.** (See *New Berne to Beaufort, N. C., inland line of navigation between.*)

## HARRASEEKET (HARRISECKET) RIVER, ME.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $10,000, | **91**, 595. |
| 1892, | 16,000, | **92**, 517. |
| 1894, | 5,000, | **95**, 562. |
| Total, | 31,000 | |

**Commerce.**

Confined to a single, small steamer, which makes daily trips to Portland, Me. **97**, 816.

**Contracts.**

**1893.** Moore & Wright, dredging, 17½ cents per c. y. s. m. ($26,250), **94**, 513.

**1895.** Moore & Wright, dredging, 17 cents per c. y. s. m. ($6,800), **95**, 562.

**Engineers.**

Chief of Engineers. Reports, **82**, 77; **89**, 31; **91**, 26; **92**, 31; **93**, 30; **94**, 29; **95**, 31; **96**, 35; **97**, 44.

Engineers in Charge:

Col. G. Thom. Report, **82**, 530.

Lt. Col. J. A. Smith, 1889–92. Reports, **89**, 550; **91**, 594.

Lt. Col. P. C. Haines, 1892–94. Reports, **92**, 516; **93**, 699; **94**, 512.

Lt. Col. D. P. Heap, 1895. Report, **95**, 561.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 566.

Maj. R. L. Hoxie, 1897. Report, **97**, 815.

Assistants:

A. C. Both. Report, **82**, 531.

W. F. Robinson. Report, **97**, 816.

**Operations.**

**1893–94.** Dredging in progress, **94**, 513.

**1894–95.** About 94,000 c. y. dredged, **95**, 561.

**1895–96.** About 69,000 c. y. dredged, completing project, **96**, 567.

**Physical characteristics.**

Description of, **89**, 551.

**Plans.**

Col. Thom, 1881, formation of a dredged channel from Weston Point to Freeport Landing, 60 f. wide and 12 f. deep at h. w., with a basin at Freeport 180 f. wide; estimate, $13,000, **82**, 531.

## HARRASEEKET RIVER, ME.—Continued.

**Projects.**

By Lt. Col. Smith, 1889, improvement of the harbor entrance by excavation of a channel 60 f. wide and 14 f. deep at m. l. w., and construction of wing dams; estimate, $36,000, **89**, 551; **92**, 516.

**Surveys.**

Ordered by act of Mar. 3, 1881, made under direction of Col. Thom, **82**, 530.

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Smith, **89**, 550.

Survey ordered by act of June 3, 1896. Examination made by Lt. Col. A. N. Damrell in 1897 (report unfavorable). **97**, 815.

## HARRIS CREEK (Prong of Back River), VA.

**Commerce.**

Estimated at 10,000 t. per annum of coal, farm produce, and oysters, **95**, 1266.

**Engineers.**

CHIEF OF ENGINEERS. Report, **95**, 167.

ENGINEER IN CHARGE. Maj. C. E. L. B. Davis, 1892–95. Report, **95**, 1265.

**Physical characteristics.**

Description of, **95**, 1266.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made by Maj. Davis, 1894 (report favorable), **95**, 1265.

## HARRISECKET. (See *Harraseeket.*)

## HARTFORD. (See *Connecticut River.*)

## HARWICH. (See *Salt Pond, Mass.*)

## HATCHEE (Big Hatchie) RIVER, TENN.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1880, | $10,000, | **80**, | 1330. |
| 1881, | 3,500, | **81**, | 1415. |
| 1882, | 3,000, | **82**, | 1555. |
| 1884, | 2,500, | **85**, | 1528. |
| 1886, | 3,000, | **86**, | 1366. |
| 1888, | 5,000, | **88**, | 1368. |
| 1890, | 5,000, | **90**, | 1906. |
| 1892, | 3,500, | **92**, | 1659. |
| Total, | 35,500 | | |

**Commerce.**

Commerce obstructed by bridges without draws, **80**, 1331.

Advantages arising from improvement, **80**, 1330, 1331; **85**, 1527.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 156; **81**, 210; **82**, 207; **83**, 216; **84**, 225; **85**, 242; **86**, 536; **87**, 201; **88**, 183; **89**, 215; **90**, 193; **91**, 246; **92**, 238; **93**, 269; **94**, 249; **95**, 278.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1880–82. Reports, **80**, 1330; **81**, 1415; **82**, 1555.

Maj. A. M. Miller, 1882–84. Reports, **83**, 1153; **84**, 1337.

Capt. E. Bergland, 1884–86. Reports, **85**, 1527; **86**, 1366.

Capt. J. H. Willard, 1886–95. Reports, **87**, 1479; **88**, 1367; **89**, 1618; **90**, 1904; **91**, 2010; **92**, 1657; **93**, 2052; **94**, 1516; **95**, 1952.

ASSISTANTS:

J. Burney. Report, **80**, 1331.

J. J. Barry. Report, **85**, 1528.

**Legislation.**

Act of State legislature declaring the river a navigable one, **80**, 1331.

**Obstructions.**

Obstruction of river by bridges without draws, **80**, 1331, 1332.

**Operations.**

**1880–81.** By hired labor, 376 snags and 2,409 logs were removed, and 16,243 trees cut down. River worked over from Bolivar to its mouth. **81**, 1415.

**1881–82.** 3,204 snags and logs removed, 636 trees cut down, and 1 wreck removed. River worked over from Bolivar to its mouth. **82**, 1555.

**1882–83.** 1,431 snags and logs removed and 679 trees cut down; 185 miles of river worked over, **83**, 1154.

**1884–85.** 969 logs and snags removed and 1,094 trees cut down; 50 miles of river worked over, **85**, 1528.

**1886–87.** 2,067 snags, stumps, and logs removed, 3,813 trees cut, and 3 cut-offs cleaned, **87**, 1480.

**1888–89.** 1,410 logs and snags removed from the channel, and 4,300 trees and shore snags and 4,684 s. y. brush cleared from the banks, **89**, 1619.

**1889–90.** 870 snags and 143 side jams removed from the channel, and

## HATCHEE (Big Hatchie) RIVER, TENN.—Continued.

2,860 trees and shore snags and 375 s. y. brush cleared from the banks, **90**, 1905.

**1891–92.** 650 snags and logs removed from the channel; 14 side jams removed; 6,700 trees cut and 6,518 trees girdled on the banks, **92**, 1659.

**1893-94.** 28,420 s. y. brush and willows cut, and about 4,500 snags and other obstructions removed, **94**, 1518.

**1894-95.** Several wrecks removed; 8,867 s. y. brush, etc., cut, and over 25,000 snags, etc., removed, **95**, 1954.

**Physical characteristics.**
Description of, **94**, 1517; **95**, 1953.

**Projects.**
By Maj. Benyaurd, 1879, removing snags, leaning trees, and logs, from Bolivar to the mouth, 240 miles; estimate, $30,000, **80**, 1331, 1342; **87**, 1479. Improvement not permanent, **90**, 1904.

**Surveys.**
Made under direction of Maj. Benyaurd, 1879, **80**, 1330.

## HAVENS ANCHORAGE, CAL. (See *Fish Rock.*)

## HAVRE BAY AND VANCE RIVER, MICH.[a]

## HAVRE DE GRACE HARBOR, MD. (See *Chesapeake Bay; Susquehanna River, Md.*)

## HAWAII. (See *Pearl Harbor* and *Miscellaneous Index.*)

## HAY LAKE CHANNEL. (See *St. Marys River, Mich.*)

## HELENA HARBOR, ARK. (See *Mississippi River.*)

## HELL GATE, N. Y. (See *East River.*)

## HEMPSTEAD BAY. (See *Woodsburg Channel, N. Y.*)

## HEMSTEAD HARBOR AND BAY, N. Y. (See *Glencove Harbor.*)

**Commerce.**
Small, **84**, 764.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 85; **81**, 108; **84**, 122.

ENGINEERS IN CHARGE:
Col. J. Newton. Report, **81**, 668.
Maj. G. L. Gillespie. Report, **84**, 764.

ASSISTANT. R. H. Talcott. Report, **81**, 669.

**Plans.**
By Col. Newton, 1881, separating the inner from the outer bay by a dam, and regulating ingress and egress by means of a lock. Estimate, $440,000. **81**, 668.

Constructing a dike 7,500 f. in length from "Bar Beach" in a southerly direction to Hick's wharf and dredging. Estimate, $163,200. **81**, 668.

Constructing 2,500 l. f. of diking from bay entrance to steamboat dock and dredging. Estimate, $83,375. **81**, 671.

**Surveys.**
Ordered by act of June 14, 1880, made, 1880, under direction of Col. Newton (report unfavorable), **81**, 668.

Of Hempstead Bay, ordered by act of August 2, 1882, made under direction of Maj. Gillespie (report unfavorable), **84**, 764.

## HENNEPIN. (See *Transportation Routes to the Seaboard.*)

## HENNEPIN CANAL, ILLINOIS RIVER, TO WATERTOWN, MISSISSIPPI RIVER (Ship canal). (See *Illinois and Mississippi Canal; Transportation Routes to the Seaboard, Second subdivision, Hennepin Canal.*)

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $30,000, | **83**, 290. |
| 1886, | 15,000, | **86**, 457. |
| Total, | 45,000. | |

**Commerce.**
Important, **83**, 1780; **86**, 1738.
Effect of water transportation on freight rates, **83**, 1781.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **71**, 57; **83**, 289; **84**, 291; **85**, 314; **86**, 309, 1708; **87**, 275, 2127.

BOARD OF ENGINEERS. Of 1886 to report upon the Hennepin Canal. Report, **87**, 2137-2141. (Lt. Cols. Comstock and Poe and Maj. Post.)

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[a] Survey.—Report March 23, 1837, estimate, $34,788.51. (H. Doc. No. 482, 55th Cong., 2d sess.)

## HENNEPIN CANAL, ILLINOIS RIVER, TO WATERTOWN, MISSISSIPPI RIVER (Ship Canal)—Continued.

ENGINEERS IN CHARGE:

Lt. Col. J. H. Wilson (35th Infantry), 1871. Report, **71**, 264, 265.

Col. J. N. Macomb, 1871. Report, **71**, 302.

Maj. W. H. H. Benyaurd, 1882–86. Reports, **83**, 1754, 1788; **84**, 1950; **85**, 2056; **86**, 1733.

Maj. T. H. Handbury, 1886. Report, **86**, 1711, 1735.

ASSISTANTS:

H. A. Ulffers, **71**, 264, 265.

G. P. Low, jr. Report, **71**, 302.

J. Worrall, C. E., **71**, 304.

H. B. Herr. Report, **83**, 1763.

G. Y. Wisner. Report, **83**, 1773.

G. A. M. Liljencrantz. Report, **86**, 1719.

**Estimates.** (See *Plans.*)

By J. Worrall, C. E., canal extending from the railroad bridge at Colona to Rock Island City, with locks 150 f. long and 30 f. wide, $902,283.45, **71**, 304. Modified by change of plan, **71**, 304.

By G. P. Low, ship canal from Hennepin, on the Illinois River, to Watertown, on the Mississippi River, including locks and dams: eastern division, 25.9 miles, $5,779,277.24; western division, 39.4 miles, $4,429,566.13; feeder division, 38.1 miles, $2,270,849.90, **71**, 303, 304, 305; total estimate, $12,479,493, **71**, 305. For commercial canal, eastern division, $1,467,202.44; western division, $1,429,708.50; feeder division, $1,002,811.70; total, $3,899,722.64, **71**, 306; **75**, ii, 530.

**Legislation.**

Relating to survey, **83**, 1755.

Form for act ceding Illinois and Michigan Canal to United States, **83**, 1787.

**Physical characteristics.**

Description of, **71**, 305.

**Plans.** (See *Estimates.*)

By G. P. Low, jr., ship canal from Hennepin, on the Illinois River, to Watertown, on the Mississippi River, 160 f. wide and 7 f. deep, locks 350 f. long by 75 f. wide: eastern division, extending from the Illinois River to the junction of the feeder at Devil's Slough, 25.9 miles, with an aggregate lift of 207 f., requiring 19 locks, **71**, 303; western division, to extend from junction of the feeder to the Mississippi near Watertown, with an aggregate lift of 92 f., requiring 9 locks, **71**, 304; feeder division, to be 140 f. wide, 7 f. deep, and 38 miles long, **71**, 305. For canal for commercial purposes, width 60 f., depth 6 f., size of locks 350 f. long by 21 f. wide, **71**, 306.

By Maj. Benyaurd, 1882, canal between Hennepin, on the Illinois River, and vicinity of Watertown, on the Mississippi River, canal prism to be 80 f. wide at water line and 7 f. deep, lock 170 f. long and 30 f. wide.

By the Marais d'Osier route, 65 miles in length; estimate, $5,811,367.

By Watertown route, 65 miles in length; estimate, $7,207,646.

By Rock Island route, 74½ miles in length; estimate, $6,672,890, **83**, 1757, 1758, 1762, 1772, 1788; **86**, 1709.

Revised in 1885 to $6,709,536, **86**, 1709.

Preference given to Marais d'Osier route, **83**, 1760, 1761; **86**, 1710, 1715, 1734; **87**, 2140.

In 1885 additional surveys were made for the Watertown and Rock Island routes and the following estimates submitted by Capt. Handbury:

Watertown route (via Penney's Slough), 65 miles in length, $6,306,552, **86**, 1709, 1713, 1722.

Rock Island route (via Penney's Slough and Rock River), 77 miles in length, $6,554,052, **86**, 1709, 1713, 1722.

Rock Island route (via Green River, revised), 74½ miles in length, $6,709,536, **86**, 1709, 1713, 1722.

The Chief of Engineers suggested adopting Rock Island route, **86**, 1710.

Advantages of Rock Island route, **86**, 1710, 1728, 1732, 1748.

The Board of Engineers of 1886 preferred the Marais d'Osier route, **87**, 2140.

**Private (corporate) work.**

Description of Illinois and Michigan Canal, **83**, 1774.

**Survey.**

By G. P. Low, jr. Report, **71**, 302.

Ordered by act of Aug. 2, 1882, **83**, 290, made under direction of Maj. Benyaurd, 1883, **83**, 1754, 1756.

History of surveys previous to 1882, **83**, 1755.

Additional surveys in 1885, **86**, 1708, 1728.

MAPS. Of Hennepin, Illinois and Michigan Canals, **87**, 2171.

## HERO ISLANDS, N. Y. (See *Lake Champlain at.*)

## HERRING RIVER, HARWICH, MASS.

**Commerce.**
Description of, **98**, 932.

**Engineers.**
CHIEF OF ENGINEERS. Report, **98**, 84.
ENGINEER IN CHARGE. Maj. D. W. Lockwood, 1897–98. Report, **98**, 932.

**Physical characteristics.**
Description of, **98**, 933.

**Surveys.**
Examination ordered by act of June 3, 1896, made by Maj. Lockwood, 1897 (report unfavorable), **98**, 933.

## HIAWASSEE RIVER. (See *Hiwassee River.*)

## HIGHLAND BAYOU, TEX.

**Commerce.**
None and none looked for, **1900**, 2414.

**Engineers.**
CHIEF OF ENGINEERS. Report, **1900**, 395.

ENGINEER IN CHARGE. Capt. C. S. Riché, 1899–1900. Reports, **1900**, 2410, 2412.

ASSISTANT. S. M. Wilcox. Report, **1900**, 2413.

**Obstructions.**
The bayou crossed by railroad, wagon, and foot bridges, and is so narrow at Hitchcock that any sort of structure is considered sufficient, **1900**, 2414.

**Physical characteristics.**
Highland Bayou empties into Galveston Bay, Tex., about 9 miles west of the city of Galveston, and is one of the adjacent streams referred to in the appropriation of Mar. 3, 1899, for improving "Brazos River" between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and the mouths of adjacent streams, **1900**, 2411.
Description of, **1900**, 2413.

**Surveys.**
Examination and survey ordered by act of Mar. 3, 1899; examination made, 1899, by Capt. Riché (report favorable); survey made, 1899, under his direction (report unfavorable), **1900**, 2413.

## HILLSBORO (HILLSBOROUGH) BAY AND RIVER, FLA. (See *Tampa Bay.*)

**Appropriation.**
1899, $125,000, **99**, 1637.

**Commerce.**
Description of. Rapidly growing. **97**, 1575, 1576.

**Contracts.**
**1899.** I. T. Brown, dredging, 19¾ cents per c. y.; rock removal, $4.90 per c. y. ($79,604.82), **1900**, 2027.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **97**, 252; **98**, 246; **99**, 284; **1900**, 323.
ENGINEERS IN CHARGE:
Lt. Col. W. H. H. Benyaurd, 1897–98. Reports, **97**, 1574; **98**, 1357.
Capt. H. Jervey, 1899. Report, **99**, 1635.
Capt. T. H. Rees, 1900. Report, **1900**, 2025.
ASSISTANT. J. W. Sackett. Report, **97**, 1576.

**Operations.**
**1899–1900.** 201,038 c. y. dredged, **1900**, 2026.

**Physical characteristics.**
Detailed description of, **97**, 1576; **99**, 1636.
Current observations, **97**, 1575.

**Projects.**
In compliance with joint resolution of Congress, 1898, Lt. Col. Benyaurd estimated that it would cost $300,000 to dredge a channel 200 f. wide in the river and 150 f. wide in the bay, with 12 f. depth, and that $1,000 would be required annually for maintenance, **98**, 1358; adopted plan, **99**, 1636.

**Surveys.**
Examination of the bay from its confluence with Tampa Bay through Hillsboro Bay and River to the city of Tampa ordered by act of June 3, 1896, made under the direction of Lt. Col. Benyaurd, 1897, **97**, 1574 (report favorable.) (See *Projects.*)
Survey made, 1899, by Capt. Jervey, **99**, 1636.

## HINGHAM HARBOR, MASS. (See *Boston Harbor, Mass.*)

**Appropriations.**

| | | |
|---|---|---|
| 1875, | [a] $10,000, | **75**, 119; **87**, 521. |
| 1886, | 6,000, | **87**, 522. |
| 1888, | 5,000, | **88**, 457. |
| 1890, | 5,000, | **90**, 507. |
| 1892, | 8,000, | **92**, 586. |
| Total, | 29,000 | |

**Contracts.**

**1886.** Boynton Brothers, dredging, 92 cents per c. y., rock removal, $27 per c. y., **87**, 522.

**1888.** G. W. Townsend, rock removal, $25 per c. y., removal of loose overlying material, $9 per c. y., **89**, 582.

**1890.** A. R. Wright, dredging, 18 cents per c. y., **91**, 658.

**1892.** G. W. Townsend & Co., ledge removal, in situ, $23.74 per c. y. ($3,038.72), **93**, 775.

**Engineers.**

Chief of Engineers. Reports, **85**, 57; **87**, 28; **88**, 29; **89**, 39; **90**, 34; **91**, 42; **92**, 48; **93**, 48; **94**, 46; **95**, 50.

Engineers in Charge:

Maj. C. W. Raymond. Report, **85**, 553.

Lt. Col. G. L. Gillespie, 1887–89. Reports, **87**, 520; **88**, 456.

Lt. Col. S. M. Mansfield, 1889–95. Reports, **89**, 580; **90**, 506; **91**, 656; **92**, 585; **93**, 774; **94**, 557; **95**, 631.

Assistant. H. F. Bothfeld. Report, **85**, 555.

**Operations.**

**1875–76.** 25,160 c. y. earth and 83 c. y. rock removed, **76**, 168; **87**, 521.

**1886–87.** 1,247 c. y. gravel and 143 c. y. rock removed, **87**, 521.

**1888–89.** 80 c. y. rock removed, **89**, 581.

**1889–90.** 93 c. y. rock removed, **90**, 507.

**1890–91.** 20,400 c. y. dredged, **91**, 565.

**1892–93.** 128 c. y. rock removed. Project completed, **93**, 775.

**Physical characteristics.**

Description of, **84**, 553; **87**, 520.

**Projects.**

The original project of 1874 provided for an improved channel on the east side of Sailors Island, past the west side of Beacon to the Hingham Wharf, 100 f. wide and 8 f. deep at m. l. w., at an estimated cost of $11,000. This project was modified Jan. 20, 1885, when it was proposed to deepen the improved channel to 10 f. at m. l. w., and to remove a mid-channel ledge lying between Chandlers and Ragged islands, measuring 128 c. y., at a total cost of $18,700, **88**, 457.

By Lt. Col. Mansfield, 1892, for the expenditure of available funds in completing the project by the removal of a mid-channel ledge, **93**, 775.

**Surveys.**

Ordered by act of July 5, 1884; made under direction of Maj. Raymond (report favorable), **85**, 555.

Maps. **88**, 456.

## HIWASSEE (HIAWASSEE) RIVER, TENN. (See *Tennessee River.*)

**Appropriations.**

| | | |
|---|---|---|
| 1876, | $10,000, | **77**, 91. |
| 1878, | 10,000, | **78**, 104. |
| 1879, | 3,000, | **79**, 140. |
| 1880, | 3,000, | **80**, 1679. |
| 1881, | 1,500, | **81**, 1860. |
| 1882, | 1,500, | **82**, 1848. |
| 1884, | 2,500, | **84**, 1650. |
| 1886, | 2,500, | **86**, 1520. |
| 1888, | 1,000, | **88**, 1606. |
| 1890, | 1,500, | **90**, 2131. |
| Total, | 36,500 | |

**Commerce.**

Important, **75**, 810; **79**, 140, 1269.

Description of; not unimportant, **93**, 2412, 2413.

The largest parts of the commerce to Chattanooga from the upper Tennessee comes out of Hiwassee River, **95**, 2313.

Annual commerce about 9,000 t., valued at about $150,000, **1900**, 3019.

**Engineers.**

Chief of Engineers. Reports, **75**, 77; **77**, 91; **78**, 104; **79**, 140; **80**, 186; **81**, 252; **82**, 245; **83**, 253; **84**, 254; **85**, 276; **86**, 267; **87**, 232; **88**, 209; **89**, 244; **90**, 220; **91**, 280; **92**, 267; **93**, 301, 307; **94**, 275; **95**, 313; **96**, 271; **99**, 410; **1900**, 468.

Engineers in Charge:

Maj. W. McFarland, 1875. Report, **75**, 809.

Capt. W. R. King, 1877–86. Reports, **77**, 598; **78**, 761; **79**, 1268; (Maj.), **80**, 1078; **81**, 1860; **82**, 1847; **83**, 1493; **84**, 1649; **85**, 1764.

Lt. Col. J. W. Barlow, 1886–92. Reports, **86**, 1519; **87**, 1754: **88**, 1605; **89**, 1833; **90**, 2130; **91**, 2259.

[a] Allotment from Boston Harbor appropriation.

## HIWASSEE (HIAWASSEE) RIVER, TENN.—Continued.

Lt. Col. H. M. Robert, 1892-93. Reports, **92**, 1920; **93**, 2412.

Capt. J. Biddle, 1893-94. Reports, **93**, 2381, 2412; **94**, 1795.

Capt. T. A. Bingham, 1895. Report, **95**, 2311.

Capt. D. C. Kingman, 1896-. Reports, **96**, 2049; (Maj.), **1900**, 3010, 3016.

ASSISTANTS:

M. Kingsley. Report, **75**, 810.

J. S. Carey, **77**, 598; **78**, 761.

**Obstruction.**

Obstruction to navigation from railroad bridge without draw, **87**, 1754.

**Operations.**

**1876-77.** Rock quarried for dams, 600 c. y., **77**, 91, 599.

**1877-78.** Removal of 403 c. y.; 879 c. y. stone quarried; 2,784 c. y. stone placed in dams; logs and bowlders removed; completion of 270 f. of south dam, **78**, 104, 761.

**1878-79.** Removal of 648 c. y. rock and gravel from channel; 2,292 c. y. rock quarried and 2,104 c. y. placed in dams; construction of 174 c. y. riprap and retaining walls, **79**, 140, 1268.

**1879-80.** 581 c. y. rock quarried; 98 c. y. rock blasted; 656 c. y. placed in dams, **80**, 1679.

**1880-81.** 157 c. y. rock blasted; 280 c. y. rock quarried; 500 c. y. put into dams, **81**, 1860.

**1881-82.** 788 c. y. bowlders removed from river and placed in dams, **82**, 1847.

**1882-83.** 65 c. y. rock, 219 c. y. bowlders, and 82 snags removed from channel; 104 c. y. riprap dam built, **83**, 1493.

**1885-86.** 64 c. y. removed from channel; 55 snags and trees removed; 432 c. y. stone quarried; 287 c. y. riprap dam built, **86**, 1520.

**1886-87.** Removal of snags, gravel, and rock, and construction of dams at Mathews Shoal, Canefield Reefs, Bunker Hill Shoal, and Magills Island, **87**, 1754.

**1889-90.** 476 logs and snags removed from the channel, and 955 trees cut from the banks, **90**, 2130.

**1891-92.** 65 overhanging trees cleared from the banks, and repairs made to plant, **92**, 1921.

**1892-93.** Portion of an old dam removed, and 167 l. f. new spur dam built at Mathews Shoal; dams strengthened and other work done on them where necessary; banks protected, and some obstructions removed, **93**, 2382.

**Physical characteristics.**

Description, **75**, 810; **93**, 2412; **1900**, 3011.

Mineral resources, **75**, 810, 811.

List of obstructions, **75**, 811, 812; **79**, 1268.

**Private (State) work.**

Appropriation by State, 1844, for improvements badly applied, **75**, 811.

**Projects.**

By Maj. McFarland, 1874, for a channel 40 feet wide and 2 feet deep at low water from mouth to Savannah, for a distance of 33 miles; estimated cost, $20,000, **75**, 810, 813. Reestimate, $30,000, **78**, 762; **79**, 140, 1269. Increased by Maj. King, in 1882, to $34,000, **82**, 1848; and in 1885 to $36,500, **85**, 1764; **87**, 1755; **91**, 2261; **92**, 1920.

**Surveys.**

By M. Kingsley, 1874, from Savannah Ford to a point below Benton, Tenn., **75**, 809, 810; **77**, 599.

Examination by J. S. Carey, 1877, of Mathews Shoal and Magils Island, **77**, 91, 598.

Examination of the stream, from its confluence with the Tennessee to mouth of Ocoee River, ordered by act of July 13, 1892, made, 1892, by Lt. Col. Robert (report favorable), **93**, 2412.

Examination and survey to the mouth of the Ocoee River ordered by act of Mar. 3, 1899, made, 1899-1900, by Maj. Kingman (report favorable) (final report to be submitted), **1900**, 3011, 3016.

## HIWASSEE, TENNESSEE, AND SAVANNAH RIVERS, GA.[a] AND TENN. (canal connecting the headwaters).

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 190; **81**, 258.

ENGINEER IN CHARGE. Maj. W. R. King. Report, **81**, 1888.

ASSISTANT. S. Whinery. Report, **81**, 1890.

**Plans.**

By Maj. King for survey costing $15,000, upon which to submit plans and estimates, **81**, 1889.

**Surveys.**

Ordered by act of June 14, 1880, **80**, 190. Report made by Maj. King, 1881, **81**, 1888.

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[a] Hiwassee River, Tenn., to Alabama River, canal. (See also *Tennessee, Hiwassee, and Savannah rivers, canal to connect.*) Examination—Report (favorable) Nov. 26, 1828. (H. Doc. No. 482, 55th Cong., 2d sess.)

**HOBOKEN.** (See *Hudson River.*)

**HOCKHOCKING RIVER.** (See *Big Hocking River.*)

**HOCKING RIVER, OHIO.** (See *Big Hocking River.*)

**HODGKINS COVE.** (See *Ipswich River, Mass.*)

**HOLLAND.** (See *Black Lake Harbor, Mich.*)

## HOLLAND (BLACK LAKE) HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1852, | $8,000.00, | S. Doc. 42, 35th Cong., 1st sess., p. 58. |
| 1866, | 55,615.31, | **66**, iii, 10. |
| 1867, | 51,000.00, | **67**, 106; **70**, 146. |
| 1870, | 10,000.00, | **70**, 43. |
| 1871, | 10,000.00, | **71**, 41. |
| 1872, | 10,000.00, | **72**, 38. |
| 1873, | 12,000.00, | **73**, 39. |
| 1874, | 15,000.00, | **74**, 45. |
| 1875, | 15,000.00, | **75**, 49. |
| 1876, | 15,000.00, | **76**, 102. |
| 1878, | 10,000.00, | **78**, 123. |
| 1879, | 6,000.00, | **79**, 165. |
| 1880, | 6,000.00, | **80**, 2026. |
| 1881, | 6,000.00, | **81**, 2231. |
| 1882, | 10,000.00, | **82**, 2312. |
| 1884, | 15,000.00, | **84**, 1989. |
| 1886, | 5,000.00, | **86**, 1769. |
| 1888, | 5,000.00, | **88**, 1914. |
| 1890, | 10,000.00, | **90**, 2653. |
| 1892, | 5,000.00, | **92**, 2350. |
| 1894, | 15,000.00, | **95**, 2794. |
| 1896, | 10,000.00, | **96**, 2692. |
| 1899, | 37,500.00, | **99**, 2915. |
| Total, | 342,115.31 | |

**Commerce.**

Importance as harbor of refuge, S. Doc. 42, 35th Cong., 1st sess., p. 87; **66**, iv, 108; **67**, 107.

Commercial interests in 1857, S. Doc. 42, 35th Cong., 1st sess., p. 87.

Justification of improvement, **66**, iv, 107.

Benefits of improvement, **67**, 107; **68**, 121.

Requirements of commerce, **75**, 49.

Discussion of local commercial interests, **77**, 915.

In 1897 rapidly increasing, **97**, 2951.

**Contracts.**

**1866.** J. Roost, materials, **67**, 58, 108; **68**, 122. L. N. Kimball, materials, **67**, 58, 108; **68**, 122. J. H. Ledlie, materials, **67**, 58, 108; **68**, 122. J. E. Miller, labor and dredging, **67**, 58, 108; **68**, 122.

**1869.** T. S. White, materials and labor, **69**, 95.

**1870.** W. B. Johnson, materials, **71**, 148, 150. J. Roost, materials, **71**, 148, 150. Pierce & Whaling, materials, **71**, 148, 150.

**1871.** C. Culbert & Co., materials and labor, **71**, 148, 150. Pierce & Whaling, materials, **71**, 148, 150.

**1872.** J. Roost, materials, **73**, 276. Culbert & Hopkins, materials and labor, **73**, 276.

**1874.** Jan Van Dyk & Co., materials and labor, **75**, 255.

**1875.** T. L. Rosser, materials and labor, **75**, 255.

**1876.** Squier & White, materials, labor, and dredging, **77**, 914.

**1878.** N. S. Gere, materials and labor, **79**, 1622.

**1879.** Squier & White, dredging, **79**, 1622.

**1882.** Dewar & Wing, crib construction, **83**, 1826. Contract modified to repair of piers, **83**, 1827.

**1891.** E. G. Crosby, timber, $18 per M f., and brush, $4 per cord. Gaylord & Wing, hemlock lumber, $12 per M f. G. W. Crouter, bolts and nails, 3.4 cents per pound, **91**, 2698.

**1897.** Green's Dredging Co., dredging, **97**, 2918.

**1898.** W. Starke, dredging, **98**, 2506.

**1899.** Greens Dredging Co., dredging. R. Love, pier repairs (removing old work, piles, timber, ironwork, stone), $24,004.17, **99**, 2916.

**1900.** Greens Dredging Co., dredging, **1900**, 3894.

**Documents.** (Not published in reports.)

S. Doc. 20, 31st Cong., 1st sess.

S. Doc. 1, 34th Cong., 1st sess.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 5, iii, 10; **67**, 24, 103; **68**, 33; **69**, 32, 105; **70**, 42; **71**, 40; **72**, 38, **73**, 38; **74**, 44; **75**, 49; **76**, 102; **77**, 108; **78**, 122; **79**, 164; **80**, 217; **81**, 295; **82**, 289; **83**, 297; **84**, 298; **85**, 320; **86**, 314; **87**, 282; **88**, 256; **89**, 301; **90**, 271; **91**, 341; **92**, 327; **93**, 371; **94**, 343; **95**, 380, **96**, 336; **97**, 426, 435; **98**, 414; **99**, 492; **1900**, 557.

BOARD OF ENGINEERS. 1869. For the consideration of certain structures for harbor improvement on Lake Michigan; opinions and recommendations, **69**, 104, 105. (Lt. Col. Raynolds, Majs. Wheeler and McFarland, and Capt. Farquhar.)

ENGINEERS IN CHARGE:

Maj. J. D. Graham, 1855–57. Report, S. Doc. 42, 35th Cong., 1st sess., p. 84.

Maj. J. B. Wheeler, 1866–69. Reports, **66**, iv, 104; **67**, 106; **68**, 121.

Maj. F. U. Farquhar, 1869–72. Re-

## HOLLAND (BLACK LAKE) HARBOR, MICH.—Continued.

ports, **69**, 94, 98; **70**, 138, 145; **71**, 148; **72**, 181.

Maj. S. M. Mansfield, 1872–80. Reports, **72**, 191; **73**, 274; **74**, 187; **75**, 255; **76**, ii, 500; **77**, 914; **78**, 1211; **79**, 1622.

Maj. F. Harwood, 1880–82. Reports, **80**, 2026; **81**, 2030.

Maj. D. P. Heap, 1882–83. Report, **82**, 2312.

Capt. D. W. Lockwood, 1883–87. Reports, **83**, 1826; **84**, 1987; **85**, 2083; **86**, 1768; **87**, 2194.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1913.

Maj. Wm. Ludlow, 1889–93. Reports, **89**, 2187; **90**, 2652; **91**, 2696; **92**, 2348; **93**, 2877.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94**, 2206; **95**, 2793; **96**, 2690; **98**, 2506.

Capt. C. McD. Townsend, 1897. Reports, **97**, 2916, 2950.

Capt. C. Harding, 1899–. Reports, **99**, 2913; **1900**, 3891.

ASSISTANTS:

J. R. Rowes. Report, S. Doc. 20, 31st Cong., 1st sess.

Capt. A. Mackenzie. Reports, **66**, iv, 105; **67**, 106; **68**, 121.

F. W. Lehnartz. Report, **1900**, 3892.

**Estimates.** (See *Plans* and *Projects*.)

By J. R. Rowes, 1849, through cut and parallel piers to 20 f. of water in Lake Michigan, $105,225.78, S. Doc. 42, 35th Cong., 1st sess., p. 84; **66** iv, 104.

By Maj. Graham, 1857, piers, close piling, pile wharfing, excavation, and dredging, $128,343.02, S. Doc. 42, 35th Cong., 1st sess., p. 86; **66**, iv, 104.

By Maj. Wheeler, 1866, completion of present channel, $106,238.04, **66**, iv, 105, 107, 109; **70**, 145; **74**, 187.

By Lt. Mackenzie, 1866, improvement at the point recommended by Maj. Graham, $242,272.75, **66**, iv, 107, 109.

By Maj. Farquhar, 1870, revetment and dredging, $30,801.75, **70**, 42, 43, 139; **74**, 188.

Extension of piers, revetment, and dredging, $100,480.65, **70**, 148.

By Maj. Mansfield, 1873, for pier extension, $50,000, **73**, 275, **74**, 188, 189; **76**, ii, 501.

Pier extension and repairs, $16,033.80, **76** ii, 500.

Pier extension, $32,000, **77**, 914.

Completion, $37,833.40, **79**, 165.

**Operations.**[a]

Operations suspended from 1852 to 1866, **66**, 5.

**1867–68.** North side, 224 l. f. crib pier built; south side, 128 l. f. crib pier built; 104,595 c. y. dredged; cribs sunk in gap; crib displaced, **68**, 33, 121; **74**, 188; **76**, ii, 503.

**1868–69.** North side, 32 l. f. crib pier and 32 l. f. superstructure built; south side, 160 l. f. crib pier and 160 l. f. superstructure built, **69**, 32, 94; **74**, 188; **76**, ii, 503.

**1869–70.** North side, 575 l. f. pile work built; south side, 32 l. f. crib pier and 32 l. f. superstructure built; repairs to piers, **70**, 42, 138; **74**, 188; **76**, ii, 503.

**1870–71.** North side, 32 l. f. crib pier built; south side, 100 l. f. crib pier built; south pier extended inward to prevent breach, **71**, 40, 148; **74**, 188; **76**, ii, 503.

**1871–72.** North side, 320 l. f. pile work and 32 l. f. superstructure built; south side, 320 l. f. pile work and 100 l. f. superstructure built; protection to north pierhead built, **72**, 38, 181; **74**, 188; **76**, ii, 504.

**1872–73.** North side, 200 l. f. pile work built; south side, 200 l. f. pile work built; 32,526 c. y. dredged; repairs to both piers, **73**, 39, 275; **74**, 188.

**1873–74.** South side, 418 l. f. pile work built, **74**, 44, 189.

**1874–75.** North side, 50 l. f. crib pier and 50 l. f. superstructure built; south side, 100 l. f. crib pier and 100 l. f. superstructure built, **75**, 49, 255.

**1875–76.** North side, 100 l. f. crib pier and 100 l. f. superstructure built; south side, 50 l. f. crib pier and 50 l. f. superstructure built, **76**, 102, ii, 500.

**1876–77.** 14,297 c. y. dredged; minor repairs, **77**, 108, 914.

**1877–78.** South side, 50 l. f. crib pier built; 35,775 c. y. dredged; 700 f. revetment repaired, **78**, 122, 1211.

**1878–79.** 15,000 c. y. dredged; 3 cribs built but not sunk; repairs, **79**, 164, 1622.

**1879–80.** 2 cribs placed in extension of north and south piers, **80**, 2026.

**1880–81.** Constructing sand-catch fences and repair of piers by hired labor; 1,560 c. y. sand dredged from entrance channel by U. S. dredge, **81**, 2231.

**1881–82.** 1,042 l. f. sand-catch fence built and repair of piers by hired labor; 9,330 c. y. dredged from channel by U. S. dredge, **82**, 2312.

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[a] Length of piers constructed from Aug., 1867, to June, 1879, **79**, 1623.

Temporary pile wharfing built in 1852, to cover and protect possible subsequent work, but was mostly destroyed by storms before any permanent pier work had been begun, S. Doc. 42, 35th Cong., 1st sess., p. 85. Damages to cribs and piers, **68**, 121; **69**, 33; **70**, 146. Artificial foundations for cribs, **66**, iv, 105, 106; **67** 106; **68** 121, **69**, 99; **70**, 145, **76**, ii, 503. Sand-tight backing for pile revetment work, **74**, 189; **76**, ii, 505. Dredging with a steam tug, cost per c. y., 30 cents, **73**, 275; **74**, 188, **76**, ii, 505. History of operations, **70**, 146; **74**, 188, **76**, ii, 500, 502, **79**, 1624. Remarks on work, **76**, ii, 505.

Abstracts of materials used and work done, **67**, 107, **68**, 122, **70**, 139, **71**, 149, **72**, 181. Revetment rendered tight against sand, **79**, 1662.

## HOLLAND (BLACK LAKE) HARBOR, MICH.—Continued.

**1882-83.** Repair of piers, **83**, 1827.

**1883-84.** 460 l. f. superstructure; north pier rebuilt by hired labor. Material furnished under contract with Dewar & Wing, **84**, 1988.

**1884-85.** Repairs to piers by hired labor, **85**, 2083.

**1885-86.** Repairs to piers by hired labor, **86**, 1769.

**1887-88.** Construction of superstructure by hired labor commenced, **88**, 1914.

**1888-89.** Repairs to piers and sand fences, **89**, 2187.

**1889-90.** 17,526 c. y. dredged, **90**, 2652.

**1890-91.** 17,500 c. y. dredged, **91**, 2697.

**1891-92.** Repairs to piers and revetments and construction of sand fence, **92**, 2348.

**1892-93.** 15,587 c. y. dredged and gauge readings made for the adjustment of the different gauges at the harbors of Lakes Michigan and Huron, **93**, 2877.

**1893-94.** 12,584 c. y. dredged, **94**, 2206.

**1894-95.** 13,997 c. y. dredged, an old wreck removed, and repairs made to south pier, **95**, 2793.

**1895-96.** 24,733 c. y. dredged, 84 c. y. stone removed, and 456 l. f. old piers repaired, **96**, 2691.

**1896-97.** Over 10,571 c. y. dredged, **97**, 2917.

**1897-98.** 12,088 c. y. dredged and 203 l. f. north pier rebuilt, **98**, 2506.

**1898-99.** 17,061 c. y. dredged, **99**, 2913.

**1899-1900.** 1,513 f. of harbor piers and revetments repaired; 28,392 c. y. dredged, **1900**, 3892.

**Physical characteristics.**

General characteristics of Black Lake, **70**, 145; **76**, ii, 502, 503, 506; **77**, 915.

Bed of marsh clay, **66**, iv, 106.

Sand drift, **73**, 275.

Scour of sand between piers, **74**, 189.

Advance of shore line, **76**, ii, 505.

Description of, **93**, 2877; **97**, 2950.

**Plans.** (See *Estimates.*)

By J. R. Rowes, 1849, through cut dredged to 10 f. joining Black Lake with Lake Michigan; parallel piers to 20 f. of water in Lake Michigan. Auxiliary bridge pier in constructing permanent work. General plan approved by Board of Engineers in 1853, and recommended by Maj. Graham; estimate, $105,225.78, **66**, iv, 104; but afterwards modified, limiting pier extension to 10 instead of 20 f. of water, S. Doc. 42, 35th Cong., 1st sess., pp. 84, 86.

By Capt. Farquhar, 1869, protection of displaced portion of south pier by enrockment and close piling, **69**, 98.

By Maj. Mansfield, for repairs, **79**, 1623.

**Private work.**

Harbor improvement by the citizens of the village of Holland (about 1860, **70**, 145) in opening a new outlet for the waters of Black Lake at the most northerly of the two sites proposed by Maj. Graham, but not the one recommended by them. Poor condition of the work in 1866, **66**, iv, 104, 105; **70**, 145; **74**, 184; **76**, ii, 502. Expenditures in improvement by the harbor commissioners of Holland, $30,000, **66**, iii, 10, iv, 106.

Dredging carried on by the citizens of Holland, **90**, 2652.

**Projects.** (See *Estimates.*)

By Maj. Graham, 1857, two parallel crib piers to 12 f. of water, and a through cut connecting Black Lake with Lake Michigan, revetted with close piling; the whole to be dredged to a depth of 12 f.; estimate, $128,343, S. Doc. 42, 35th Cong., 1st sess., pp. 85, 89, 175; **66**, iv, 104.

By Maj. Wheeler, 1866, continuing the improvement begun by the citizens of Holland. Pier extension to 12 f. of water in Lake Michigan. Close piling to 12 f. of water in Black Lake. Sheathing in cut. Dredging to 12 f. in channel, estimate, $106,238.04, **66**, iv, 104, 106; **67**, 24, 106; **68**, 33, 121; **70**, 145; **74**, 187; **76**, ii, 503. Reasons governing choice of site for improving harbor entrance, **66**, iv, 104, 106; **67**, 106.

By Capt. Farquhar, 1869, repairs to old north and south brush piers. Protection pier to sand hill, **69**, 98. Approved and recommended by Board of Engineers, **70**, 146.

By Board of Engineers, 1869, protection of portion of the south pier lately built by an enrockment, **69**, 104. Dredging at head of cut, **69**, 94; **70**, 146; approved by the Chief of Engineers, **69**, 105; **70**, 146. Manner of construction of pile pier proposed for this and other works on Lake Michigan approved with certain provisos, **69**, 104, 105.

By Capt. Farquhar, 1869, to apply $4,000 from the appropriation of this harbor toward the purchase of a dredging outfit for use at this and neighboring harbors, **69**, 85.

By Maj. Farquhar, 1870, further pier extension, to depend on the relative cost each year of dredging and pier building, **70**, 42, 139; **76**, ii, 503.

By Maj. Mansfield, 1873, pier extension, **74**, 188; **76**, ii, 501, 506. 1876, extension of south pier and repairs to old work, **76**, 102, ii, 500. 1877, crib pier extension, **77**, 108, 914.

## HOLLAND (BLACK LAKE) HARBOR, MICH.—Continued.

The projects of 1866 and 1873 proposed the formation of a channel of entrance of navigable width and not less than 12 f. deep, by pier extension and dredging. Estimated cost in 1866, $106,238.04, **66**, iv, 104, **83**, 1827. From 1852 to 1884, $238,673.23 had been expended, and had resulted in obtaining a channel of entrance 9 f. deep, **84**, 1988, 1989.

In 1883 Capt. Lockwood proposed placing an additional crib 50 f. long at the outer end of each pier, and completing the repairs to the piers at an estimated cost of $35,000, **84**, 1989.

In 1891 Maj. Ludlow proposed the completion of the improvement by pier extension, repairs, and dredging; estimated cost, $45,000, **91**, 2697.

By Capt. Townsend, 1897, extending north pier 800 f. and south pier 700 f., and dredging a 16-f. channel, and also repair of existing structures; estimate, $240,000, **97**, 2950; (drawings), **99**, 2916.

**Surveys.**

Directed by Maj. Graham, 1856, S. Doc. 42, 35th Cong., 1st Sess., p. 84.

Directed by Maj. Wheeler, 1866, made by Lt. Mackenzie, **66**, iv, 104, 105; **67**, 106; **76**, ii, 502.

Directed by Maj. Wheeler, 1868, **76**, ii, 503.

Directed by Maj. Farquhar, 1869, 1870, 1871, **76**, ii, 504.

Directed by Maj. Mansfield, 1874, **76**, ii, 505.

Soundings taken, 1877, **78**, 1211.

Survey with a view to obtaining a depth of 16 f. ordered by act of June 3, 1896, made, 1897, by Capt. Townsend, (see *Projects*), **97**, 2950.

MAPS. **66**, No. 5.

## HOLMES HOLE, MASS.[a] (See *Marblehead Harbor, Mass.*)

## HOLMES RIVER, FLA. AND ALA.[b] (See *Choctawhatchee River; Lagrange Bayou, Fla.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 141; **81**, 189; **82**, 185.

ENGINEER IN CHARGE. Capt. A. N. Damrell. Report, **82**, 1308.

ASSISTANT. H. Haines. Report, **82**, 1308.

**Plans.**

By Capt. Damrell, 1881, for removing snags and similar obstructions from the mouth of the river to a point 35 miles above; estimate, $5,000, **82**, 1308.

**Survey.**

Ordered by act of June 14, 1880, made, 1880, under direction of Capt. Damrell (report favorable), **82**, 1308.

## HOLSTON RIVER, TENN. AND VA.[c]

**Commerce.**

Description of, **1900**, 3065.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 190; **81**, 258; **85**, 279; **87**, 236; **99**, 410; **1900**, 469.

ENGINEERS IN CHARGE:

Maj. W. R. King. Reports, **81**, 1878; **85**, 1773.

Lt. Col. J. W. Barlow. Report, **87**, 1772.

Maj. D. C. Kingman, 1900. Reports, **1900**, 3058, 3063.

ASSISTANTS:

W. G. Sanborn. Report, **81**, 1880.

C. A. Locke. Report, **87**, 1773.

**Physical characteristics.**

Description of, **81**, 1880; **87**, 1774; **1900**, 3060.

**Plans.**

By Maj. King, 1881, channel from 60 to 80 f. wide and 1½ f. deep at extreme low water, for a distance of 171 miles, from Saltville to North Fork junction, to be secured by rock excavation, wing-dam construction, and the removal of trees and snags. Estimate, $242,913, **81**, 1879, 1883, 1885.

By Lt. Col. Barlow, improved channel 100 f. wide and 20 in. deep at low water, from the Forks to Knoxville, a distance of 154 miles, by removal of obstructions and contraction of channel by wing-dams. Estimate, $347,000, **87**, 1773.

**Surveys.**

Survey made about 1832. (H. Doc. 482, 55th Cong., 2d sess.)

Ordered by act of June 14, 1880, made,

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[a] Survey—Report, Apr. 24, 1826. (H. Doc. No. 482. 55th Cong., 2d sess.)

[b] Examination—Report (favorable), Jan. 28, 1845. (H. Doc. No. 482, 55th Cong., 2d sess.)

[c] Survey—Report July 15, 1832, estimate (including Tennessee River), $58,161.27. (H. Doc. No. 482, 55th Cong., 3d sess.)

### HOLSTON RIVER, TENN. AND VA.—Continued.

1880, under direction of Maj. King, **81**, 1878.

Survey made about 1881 (estimate cost of improvement, $322,913). (H. Doc. 482, 55th Cong., 2d sess.)

Examination ordered by act of Aug. 5, 1886, made under direction of Lt. Col. Barlow, **87**, 1772.

Examination and survey of Holston River, from its mouth to Kingport, Tenn., ordered by act of Mar. 3, 1899. Preliminary report submitted, 1899, by Maj. Kingman, **1900**, 3059.

### HOMMACKS, MD. (See *Chincoteague Bay to Delaware Bay.*)

### HOMMOCKS INLET, MD. (See *Delaware line, etc.*)

### HOMOCHITTO RIVER, MISS.

**Appropriation.**

1899, $16,000, **99**, 1863.

**Commerce.**

Description of, **93**, 1840; **97**, 1778.

3,815 tons annually, 1899, **1900**, 2281.

**Contracts.**

**1899.** J. H. Gardner, hire of snagging plant, $62.30 per day of eight hours ($13,986.35), **1900**, 2281.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 225; **93**, 251; **97**, 291; **98**, 281; **99**, 337; **1900**, 382.

ENGINEERS IN CHARGE:

Capt. T. Turtle. Report, **85**, 1429.

Maj. J. B. Quinn, 1893–99. Reports, **93**, 1839; **97**, 1777; **98**, 1489; **99**, 1862.

Maj. H. M. Adams, 1900. Report, **1900**, 2280.

ASSISTANT:

C. D. Anderson. Report, **85**, 1429.

P. H. Thomson. Reports, **93**, 1840; **97**, 1778.

**Operations.**

**1899–1900.** 5,688 obstructions removed, **1900**, 2280.

**Physical characteristics.**

Description of, **93**, 1840; **97**, 1778.

Bars, snags, etc., obstruction, **93**, 1840; **97**, 1778.

**Projects.**

By Maj. Quinn, 1898, for dredging obstructions mouth to the Yazoo and Mississippi Valley Railroad, 60 miles, for boats drawing 6 f.; estimate, $16,000, **98**, 1489; **99**, 1862.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of Capt. Turtle (report unfavorable), **85**, 1429.

Examination, mouth to the Louisville, New Orleans and Texas Railroad bridge, ordered by act of July 13, 1892, made under direction of Maj. Quinn (favorable report by Maj. Quinn, improvement not advised by D. E. and C. E.), 1892, **93**, 1839.

Examination, mouth to Yazoo and Mississippi Valley Railroad, ordered by act of June 3, 1896, made, 1897, under direction of Maj. Quinn (report favorable), **97**, 1777.

Concurrent resolution of Congress called for plan and estimate of cost of improving river, mouth to Yazoo and Mississippi Railroad; submitted by Maj. Quinn, 1898, **98**, 1489.

### HOMOSASSA BAY, FLA.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 214.

ENGINEER IN CHARGE. Maj. A. N. Damrell. Report, **85**, 1373.

**Projects.**

In 1884 improvement would cost from $100,000 to $180,000, **85**, 1373.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of Maj. Damrell (report unfavorable), **85**, 1373.

### HOMOSASSA RIVER, FLA.

**Commerce.**

Description of, **89**, 1353.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 174.

ENGINEER IN CHARGE. Capt. W. M. Black, 1888. Report, **89**, 1353.

ASISTANT. Lt. D. D. Gaillard. Report, **89**, 1354.

**Physical characteristics.**

Description of, **89**, 1354.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Black (report unfavorable) **89**, 1353.

## HOODS CANAL. (See *Puget Sound.*)

## HORN ISLAND. (See *Pascagoula Harbor and River, Miss.*)

## HORSESHOE SHOALS. (See *Delaware River.*)

## HORTON POINT, N. Y.—BREAKWATER.

**Commerce.**
Necessity for harbors of refuge on Long Island Sound, **85**, 701.

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 95.
ENGINEER IN CHARGE. Lt. Col. W. McFarland. Report, **85**, 701.

**Plans.**
Harbor of refuge would cost not less than $1,000,000; selection of site should be made only after careful study of the whole coast line, **85**, 702.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Col. McFarland (see *Plans*), **85**, 701.

## HOSPITAL POINT, VA.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 120.
ENGINEER IN CHARGE. Lt. G. J. Fiebeger, 1888. Report, **89**, 964.

**Physical characteristics.**
Description of, **89**, 964.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Fiebeger (report unfavorable), **89**, 964.

## HOUMA. (See *Black Bayou, La.*)

## HOUSATONIC RIVER, CONN.

**Appropriations.**

| | | |
|---|---|---|
| 1870, | [a]$2,700, | **79**, 345. |
| 1871, | 15,000, | **71**, 85. |
| 1872, | 15,000, | **72**, 83. |
| 1873, | 10,000, | **73**, 91. |
| 1874, | 10,000, | **74**, 102. |
| 1875, | 5,000, | **75**, 105. |
| 1878, | 5,000, | **78**, 52. |
| 1880, | 2,000, | **80**, 461. |
| 1881, | 2,000, | **81**, 602. |
| 1882, | 2,000, | **82**, 616. |
| 1884, | 2,500, | **84**, 651. |
| 1886, | 5,000, | **86**, 643. |
| 1888, | 35,000, | **88**, 552. |
| 1890, | 35,000, | **90**, 634. |
| 1892, | 20,000, | **92**, 683. |
| 1894, | 25,000, | **95**, 790. |
| 1896, | 25,000, | **96**, 705. |
| 1899, | 15,000, | **99**, 1167. |
| Total, | 231,200 | |

**Commerce.**
Important, **73**, 1019; **72**, 894.
Obstructions to navigation, **72**, 894.
Description of, **97**, 983.

**Contracts.**
**1871.** R. W. Meyers, dredging, 18 cents per c. y.; rock removal, $1.90 per c. y., **71**, 779.
**1872.** F. H. Smith, dredging, 23.95 cents per c. y., **72**, 891. A. A. Bouker, building embankment, **72**, 891.
**1877.** M. F. Brainard, dredge, scows, and tug, **77**, 215.
**1878.** J. M. Seward, dredging, 16 cents per c. y., **79**, 344.
**1881.** J. M. Seward, dredging, 16 and 20 cents per c. y., **81**, 602. J. McDermott, dredging, 23 cents per c. y., **82**, 617.
**1885.** Lewis & Merwin, dredging, **86**, 643.
**1886.** F. H. Smith, removal of Davis Rock and jetty, **87**, 609.
**1889.** R. Parrott, hire of dredging plant, $8.50 per hour, **89**, 692. Wm. H. Morton, riprap granite, $1.49 per ton, **89**, 692.
**1890.** Brown & Fleming, breakwater extension, total of $26,600, **91**, 777. R. Parrott, hire of dredging plant, $16 per hour, **91**, 777.
**1892.** E. Brainard, dredging 18,300 c. y., at 24½ cents per c. y., **93**, 934. Brown & Fleming, $1.12 per t. for breakwater stone ($8,400), **93**, 936. W. H. Beard, dredging, hire of dredging plant, $18.50 per hour, **93**, 936.
**1893.** D. V. Howell, dike construction, stone at $1.27 per long t. ($2,540), **93**, 936.
**1894.** S. & E. S. Belden, stone for breakwater, $1.09 per long t. ($25,000), **95**, 790.
**1895.** S. & E. S. Belden, 736 t. stone, $1.33 per t., **96**, 704.

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[a] Allotments for survey.

## HOUSATONIC RIVER, CONN.—Continued.

**1896.** R. G. & J. S. Packard, dredging, 19¾ cents per c. y., s. m. ($7,000,) **96**, 706.

**1897.** S. & E. S. Belden, repairs to breakwater, stone, at $1.11 per gross t. ($6,660). J. P. Randerson, dredging, 23½ cents per c. y. ($11,750). **97**, 958. Last contract price reduced to 20 cents, material being placed on shore, **98**, 959.

**1900.** Newburgh Dredging Co., dredging, 28 cents per c. y. ($4,999.40), **1900**, 1338.

**Documents.** (Not published in reports.)

H. Doc. 62, 41st Cong., 2d sess., **70**, 452. H. Doc. 95, 41st Cong., 3d sess., **71**, 777.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 31, 76; **71**, 85; **72**, 83; **73**, 91; **74**, 102; **75**, 104; **76**, 52; **77**, 47; **78**, 52; **79**, 58; **80**, 79; **81**, 93; **82**, 94; **83**, 90; **84**, 96; **85**, 85; **86**, 85; **87**, 48; **88**, 50; **89**, 62; **90**, 56; **91**, 69; **92**, 73; **93**, 79; **94**, 71; **95**, 80; **96**, 77; **97**, 92, 105; **98**, 97; **99**, 110; **1900**, 126.

ENGINEERS IN CHARGE:

Maj. D. C. Houston, 1870. Report, **70**, 454.

Maj. G. K. Warren, 1870–75. Reports, **70**, 452; **71**, 777, 781; **72**, 891, 893; **73**, 1013; **74**, ii, 261.

Maj. J. W. Barlow, 1875–83. Reports, **75**, ii, 256; **76**, 226; **77**, 215; **78**, 403; **79**, 344; **80**, 460; **81**, 601; **82**, 615.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 518; **84**, 650; **85**, 649.

Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 642; **87**, 606; (Col.) **88**, 551, 554; **89**, 688; **90**, 631; **91**, 773; **92**, 680.

Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 932; **94**, 654; (Col.) **95**, 787.

Maj. H. M. Adams, 1896. Report, **96**, 703.

Maj. S. S. Leach, 1897–. Reports, **97**, 956, 979; **98**, 959; **99**, 1166; **1900**, 1337.

ASSISTANTS:

T. G. Ellis, **70**, 453; **72**, 893.

W. S. Edwards, **70**, 453; **72**, 893. Report, **71**, 785.

H. Harding. Reports, **72**, 894; **73**, 1015.

H. N. Babcock. Report, **74**, ii, 263.

T. N. Lincoln. Report, **75**, ii, 257.

G. H. Birnie. Report, **78**, 347.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Warren, 1871, sea wall and filling, $130,700; breakwater, $237,775; dredging at outer bar, $12,000, **71**, 783.

By W. S. Edwards, low-water channel 7 f. in depth, $24,486, **71**, 711, 786.

By H. Harding, 1872, removal of Drew's Rock, $6,285, **72**, 895. Building a wing dam at Drew's Rock, $627, **72**, 895.

By H. Harding, 1873, widening and deepening channels and removing rocks, $58,000, **73**, 1019.

**Operations.**

**1870–71.** Operations commenced, **71**, 779.

**1871–72.** Wing dam built at Sow and Pigs Rocks; 28,922.4 c. y. dredged from Drew's Bar, making channel 80 f. wide and 7 f. deep; 9,447.85 c. y. dredged from Mill Bar, making channel 42 f. wide and 7 f. deep, **72**, 83, 893, 894; **79**, 346.

**1872–73.** 7,739 c. y. dredged from channel between Derby and Huntington; channel 1,500 f. long, 42 f. wide, and 6 f. deep; 20,385 c. y. dredged from Two-Mile Island Bar; channel 2,300 f. long, 75 f. wide, and 7 f. deep; 426 c. y. deposited on jetty, **73**, 91, 1013, 1018; **74**, ii, 263; **79**, 346.

**1873–74.** Removing 2,246 c. y. of ballast; dredging 17,019 c. y. at Mill Bar, 5,052 c. y. at Drew's Bar, 70,197 c. y. at Crofut's Bar, **74**, 102, ii, 262, 263.

**1874–75.** 7,883 c. y. dredged from Two-Mile Island Bar; 1,795 c. y. from Drew's Bar; 10,691 c. y. from Huntington Dock; 7,186 c. y. from Crofut's Bar, **75**, 104, ii, 256, 257, 258.

**1875–76.** 1,636 c. y. dredged from channel at Drew's Rock, **76**, 52, 226.

**1876–77.** 21,682 c. y. dredged from channel at Drew's Rock, **77**, 47, 215.

**1878–79.** 26,222 c. y. dredged, **79**, 58, 347.

**1880–81.** 9,290 c. y. sand dredged from channel, **81**, 601.

**1881–82.** 7,818 c. y. dredged from channel, **82**, 616.

**1885–86.** 14,394 c. y. dredged, **86**, 643.

**1886–87.** 37,494 c. y. dredged from bar at mouth of river without cost to the United States; 169 c. y. rock removed from Drew's Rock, **87**, 607.

**1887–88.** Removal of Drew's Rock and jetty completed to a depth of 7 f. m. l. w; tidal observations taken, **88**, 532.

**1889–90.** 5,063 t. of granite riprap delivered in breakwater; 35,674 c. y. dredged, **90**, 633, 634.

**1890–91.** 7,443 t. of stone delivered in the breakwater, completing 2,090 l. f.; 2,176 c. y. dredged, **91**, 775.

**1891–92.** 17,150 t. riprap granite placed in the breakwater, extending the same 1,282 f.; 13,613 c. y. dredged, **92**, 682.

**1892–93.** 22,208 c. y. dredged, and 3,300 t. stone placed in breakwater, **93**, 934.

**1893–94.** 15,861 c. y. dredged; 5,482 t. stone placed in breakwater, and 2,045 t. stone placed in bank below Stratford, **94**, 657.

**1894–95.** 7,197 t. stone placed in breakwater, **95**, 789.

## HOUSATONIC RIVER, CONN.—Continued.

**1895–96.** 7,446 t. stone placed in breakwater, and 5,074 c. y. dredged, **96**, 704.

**1896–97.** About 36,000 c. y. dredged, and 6,652 t. stone placed in repair of breakwater, **97**, 957.

**1897–98.** 53,355 c. y. dredged, **98**, 959.

**Physical characteristics.**

Descriptions of, **70**, 454; **71**, 781, 784; **72**, 894, 895; **73**, 1016–1019; **74**, ii, 263; **75**, ii, 256; **86**, 642; **88**, 551.

Table of tidal observations, **71**, 779, 785; **73**, 1013, 1015.

Effect of jetty at Drew's Rock, **75**, ii, 256; **76**, 226; **77**, 216; **93**, 932; **96**, 703; **97**, 980.

Distances above Long Island Sound to the principal bars and other points on the river, **96**, 703.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Warren, 1871, improvements of mouth of river by a sea wall 2,100 f. long and 12 f. high above m. l. w., 8 f. wide at top and 14 f. wide at m. l. w., and by closing new outlet with riprap and brush; also to build a breakwater 2,100 f. long and 6 f. wide on top, with batter 4 to 1 to foundation, latter to be of stone thrown to slope and paved and protected at foot by riprap; finally, to dredge a channel through outer bar 200 f. wide and 7 f. deep; total estimate, $380,475, **71**, 782.

By H. Harding, 1872, removal of Drew's Rock; estimate, $6,285, **72**, 895.

By Maj. Barlow, 1877, removal of jetty and Drew's Rock, **77**, 215; **78**, 52, 403; **79**, 344.

By G. H. Birnie, 1879, removal of jetty, **79**, 348.

**Private work.**

Dredging done by oystermen on the outer bar an aid to improvement, **97**, 985.

**Projects.** (See *Estimates* and *Plans.*)

In 1871 Maj. G. K. Warren proposed the formation of a channel 100 f. wide and 7 f. deep from Derby to Long Island Sound by dredging and the construction of jetties, also the formation and protection of a dredged channel at the mouth by a breakwater from Milford Beach; estimate, $404,961, **71**, 781, 783, 786; **86**, 642; **87**, 606.

In 1879 Maj. Barlow proposed a riprap jetty in place of the previously proposed breakwater, **79**, 345; **87**, 607.

In 1884, after an aggregate appropriation of $71,200, Lt. Col. McFarland proposed the removal of Drews Rock and the construction of the riprap jetty as per previous projects; estimate, $30,000, **84**, 650, 651; **87**, 607.

In 1887 Lt. Col. Houston recommended the extension of a riprap breakwater from Milford Beach to the 12-f. curve of depth, and the dredging of a channel 7 f. deep and 200 f. wide through the bar at the mouth of the river, and thence to Derby a channel 100 f. wide; estimate, $202,000, **87**, 608; **91**, 774; **92**, 681.

In 1897 Maj. Leach estimated it would cost $19,000 to improve the river, and that $4,000 would be required every alternate year for maintenance, **97**, 985.

**Surveys.**

Surveys ordered and in progress, **70**, 31, 76; **71**, 85, 785.

By W. S. Edwards, 1871, **72**, 893, 895.

By H. Harding, 1873, of river at the mouth and at Derby and Huntington, **73**, 1015, 1018.

By H. N. Babcock, 1874, from Mill Bar to railroad bridge, **74**, ii, 264.

Examination of river, 1879, **79**, 344.

Survey ordered by act of June 3, 1896, made by Maj. Leach, 1897 (report favorable). (See *Projects.*) **97**, 979.

MAPS.

Section of proposed sea wall, **71**, 782; **82**, 616; **86**, 642; **87**, 608.

## HOUSTON, TEX. (See *Galveston Bay.*)

## HUDSON BAY, PASCO COUNTY, FLA.

**Commerce.**

Description of, **1900**, 2074.

Commerce, 1897–99, inclusive, was estimated at $36,985, $78,781, and $131,525, respectively, **1900**, 2067.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **99**, 288; **1900**, 327.

ENGINEER IN CHARGE. Capt. H. Jervey, 1900. Reports, **1900**, 2066, 2069.

ASSISTANTS:

W. H. Caldwell. Reports, **1900**, 2068, 2071.

P. B. Bird. Report, **1900**, 2073.

**Physical characteristics.**

Description of. Town of Hudson on shoal west coast of Florida, about 60 miles distant from Tampa Bay entrance, and 15 miles north of Anclote Keys. The indentation of the coast (bay) is hardly noticeable. **1900**, 2066.

**Projects.**

Capt. Jervey estimated, 1899, it would cost not less than $200,000 for a navigable channel 6 f. deep m. l. w., and bottom width 60 f., **1900** 2070.

**Surveys.**

Examination and survey ordered by act of Mar. 3, 1899, made, 1899, under direction of Capt. Jervey (report unfavorable). (See *Projects.*) **1900**, 2066, 2069.

## HUDSON HARBOR, WIS. (See *St. Croix Lake and River, Minn. and Wis.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 229; **91**, 274, 2218.

ENGINEERS IN CHARGE:

Maj. C. J. Allen, 1886. Report, **87**, 1723.

Maj. W. A. Jones, 1891. Report, **91**, 2219.

ASSISTANT. F. T. Hampton. Report, **87**, 1723.

**Physical characteristics.**

Description of, **87**, 1723; **91**, 2219.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Maj. Allen (report unfavorable), **87**, 1723.

Examination ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Jones (report unfavorable), **91**, 2221.

## HUDSON RIVER, N. Y.[a] (See *Great Lakes; Harlem River; New York Harbor; Nyack Harbor; Rondout Harbor; Tarrytown, N. Y.*)

| Parts. | Appropriations. |
|---|---|
| A.—Troy to New Baltimore | $4,646,444.56 |
| B.—At Jersey City | 25,000.00 |
| C.—Ellis Island to Constable Hook; in front of Jersey City and Hoboken; Weehawken to Bergen Point, N. J | |
| D.—Troy to mouth of canal | |
| E.—New Baltimore to Coxsackie | |
| Total | 4,671,444.56 |

### Part A.—Hudson River, Troy to New Baltimore, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1834, | $70,000 00, | **66**, iii, 29, iv, 215. |
| 1836, | 100,000.00, | **66**, iii, 29, iv, 215. |
| 1837, | 100,000.00, | **66**, iii, 29, iv, 215. |
| 1838, | 100,000.00, | **66**, iii, 29, iv, 215. |
| 1852, | 50,000.00, | **66**, iii, 29, iv, 215. |
| 1864, | [b] 33,000.00, | (allotment), **66**, iii, 20, 21, 29, iv, 215; **67**, 441. |
| 1866, | 50,000.00, | **66**, iii, 21, 29, iv, 215; **67**, 442; **77**, 226. |
| 1867, | 305,188.00, | **67**, 441. |
| 1868, | 85,000.00, | (allotment), **68**, 25, 64, 712; **69**, 55; **70**, 432. |
| 1869, | [c] 89,100.00, | (allotment), **69**, 22, 55. |
| 1870, | 40,000.00, | **70**, 73; **71**, 82. |
| 1871, | 40,000.00, | **71**, 82. |
| 1872, | 40,000.00, | **72**, 79, 801. |
| 1873, | 40,000.00, | **73**, 84. |
| 1874, | 40,000.00, | **74**, 94, ii, 159. |
| 1875, | 40,000.00, | **75**, 100, ii, 199. |
| 1876, | 50,000.00, | **76**, 54, 238; **77**, 49, 226. |
| 1878, | 70,000.00, | **78**, 55, 412. |
| 1879, | 30,000.00, | **79**, 60, 369. |
| 1880, | 20,000.00, | **80**, 474. |
| 1881, | 15,000.00, | **81**, 619. |
| 1882, | 10,000.00, | **82**, 643. |
| 1884, | 30,000.00, | **84**, 699. |
| 1886, | 26,250.00, | **86**, 669. |
| 1888, | 75,000.00, | **88**, 593. |
| 1890, | 150,000.00, | **90**, 696. |
| 1892, | 187,500.00, | **92**, 746. |
| 1893, | 500,000.00, | **93**, 1016. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1894, | $145,000.00, | **95**, 909. |
| 1895, | 500,000.00, | **95**, 909. |
| 1896, | 480,000.00, | **96**, 836. |
| 1897, | 475,000.00, | **97**, 1006. |
| 1898, | 160,406.56, | **98**, 1054. |
| 1899. | 100,000.00, | **99**, 1297. |
| 1900, | 400,000.00, | **1900**, 1492. |

Total, 4,646,444.56

**Commerce.**

Description of, **67**, 412; **68**, 711; **70**, 428; **71**, 723; **72**, 802; **73**, 934; **76**, 237; **77**, 226.

Opposition of Schuyler Steam Tow-Boat Line to plan of improvements, **80**, 480, 486; **85**, 690.

Estimated annual valuation of, **89**, 759.

Amount and value of the commerce of the Hudson River, **90**, 698; **92**, 761.

**Contracts.**[d]

**1866.** E. R. Seward, stone, **66**, iv, 216.

**1867.** E. R. Seward, stone; M. Lewis, materials, **67**, 444. E. R. Seward, materials and labor; R. N. Gere, materials and labor; William Fuller, materials; S. Cunliff, materials, **67**, 444; **68**, 720, 721. J. L. Powley, materials; Thomas Flood, materials and labor; J. Hutchinson, materials; M. O. Caldwell, materials; T. S. Van Hovenburgh, dredging, **68**, 720, 721.

**1868.** E. R. Seward, materials and labor; R. N. Gere, materials and dredg-

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[a] Waterford to Schodac Island. Survey—Report 1831, estimate $221,504.10. Above and below Albany. Survey—Report Nov. 30, 1843. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Erroneously called $35,000, **66**, ii, 24, 28, iii, 29.

[c] Erroneously called $90,000, **69**, 385; **70**, 432; **77**, 226.

[d] Bids thrown out for attempts to defraud the Government, **74**, ii, 159; for informality, **75**, ii, 200.

## HUDSON RIVER, N. Y.—Continued.

### Part A.—Hudson River, Troy to New Baltimore, N. Y.—Continued.

ing; J. L. Powley, materials; D. Davis, materials; Templeton & Payne, labor; Plant's Manufacturing Company, materials; C. B. Benson, labor; S. Strong, materials; White & Boynton, materials and labor, **68**, 720, 721.

**1870.** E. R. Seward, removing rock, **71**, 720; **72**, 799, 800; **73**, 932; **74**, ii, 158.

**1871.** J. De Lacey, building dike, **72**, 800.

**1872.** C. Johnson, building dike, **75**, ii, 195.

**1873.** J. De Lacey, building dike, **74**, ii, 159; **75**, ii, 195.

**1874.** J. De Lacey, repairing, **75**, ii, 195, 196. W. D. Fuller, building dike, **75**, ii, 195.

**1875.** J. H. Marshall, building dike, **76**, 236, 238.

**1876.** W. D. Fuller, building dike, **77**, 227.

**1877.** J. H. Marshall, building dike, **78**, 412.

**1878.** J. H. Marshall, building dike. W. D. Fuller, materials and labor. **79**, 370.

**1881.** Stanton & Doyle, rock removal, **82**, 642, 644. W. D. Fuller, dike construction, **82**, 642, 644.

**1882.** Luce & Hoskins, riprap stone, **83**, 528.

**1886.** J. B. Marshall & Co. and W. D. Fuller, repair of dikes, **87**, 657.

**1890.** Wm. Fuller & Sons, pine piles, $11\frac{7}{8}$ cents per l. f.; round timber, $7\frac{7}{8}$ cents per l. f.; square timber, $39 per M f. B. M.; spike and wire, $3\frac{7}{8}$ cents per lb.; rubblestone, 94 cents per c. y., and large stone, $1.28 per c. y., **90**, 698.

**1891.** Wm. Fuller & Sons, dike construction and repair, total, $36,054, **91**, 876. P. W. Myers, dredging, $14\frac{3}{4}$ cents per c. y.; E. M. Payne, dredging, $17\frac{8}{9}$ cents, $11\frac{8}{9}$ cents, and 21.9 cents per c. y., **91**, 869.

**1892.** P. S. Ross, removing rock and sand covering in place, $5, and 50 cents per short ton, respectively ($965,000); Edwards, Howlett & Thompson, dike construction (timber, stone, ironwork, etc.), aggregate, $231,302; dredging, 4,620,000 c. y., 20.7 cents per c. y. ($956,340), **93**, 1017.

**1895.** J. J. Cuddy, paving of dikes, 21 cents per s. y. ($4,380), **95**, 909.

**1896.** W. Parrott, construction and repair of dikes (piles, ironwork, stone, etc.), aggregate, $22,777.50, **97**, 1007. Edwards, Howlett & Thompson, supplementary to contract of 1892, dredging, 700,000 c. y., 38 cents per c. y., increased price, **97**, 999; **98**, 1048.

**1897.** W. D. Fuller, furnishing rubblestone, 94 cents per c. y.; paving stone, $1.95 per c. y. ($6,027), **98**, 1055.

**1899.** Kirk, Driscoll & Co., construction and repair of dikes (piles, timber, ironwork, stone, etc.), aggregate, $49,782, **99**, 1298.

**1900.** J. Du Bois, construction and repair of dikes (piles, timber, ironwork, stone, and dredging), aggregate, $121,007.50, **1900**, 1453.

Open market agreements for removal of wrecks, furnishing stone, dredging, etc., **93**, 1009, 1010; **94**, 727; **95**, 903; **96**, 829, **97**, 999.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 3, ii, 24, 28, 41, iii, 20, 21, 29, iv, 205; **67**, 43, 444; **68**, 64; **69**, 54, 387; **70**, 72; **71**, 81, 82; **72**, 79; **73**, 84; **74**, 94; **75**, 100; **76**, 54; **77**, 48; **78**, 54, 411; **79**, 60, 367; **80**, 81, 479, 480; **81**, 97; **82**, 97; **83**, 93; **84**, 101; **85**, 94; **86**, 92; **87**, 56, 67; **88**, 57; **89**, 71; **90**, 63, 332; **91**, 81; **92**, 84, 751; **93**, 92; **94**, 83; **95**, 95; **96**, 103; **97**, 105; **98**, 131; **99**, 151; **1900**, 171.

BOARDS OF ENGINEERS:

Convened in 1834; considered that an improved channel could only be maintained by floods; recommended lines of longitudinal dikes from Troy to New Baltimore, **66**, iii, 20, iv, 206, 207. (Col. Totten, Lt. Col. Thayer, and Capt. Talcott.)

Convened May 21, 1867, at Albany; recommended adoption of modified project for dikes; dredging; side reservoirs, and protection of banks by revetments. Report, **67**, 445, 446. (Cols. Bache and Brewerton, Lt. Col. Newton, and Maj. Abbot.)

Convened at New York Mar. 5, 1880, to report upon Gen. Newton's plan for improvement of the Hudson at New Baltimore, which, in the opinion of the Schuyler Steam Tow-Boat Co. would result in injury to the navigation of the river, **80**, 480; **85**, 690. (Col. Tower and Maj. Abbot.)

Harbor-line board convened Mar. 18, 1890, by S. O. No. 49, at New York City, to examine and report upon location of harbor lines in the Hudson River from Troy to New Baltimore. Report, **90**, 770, 772. (Cols. Abbot, Craighill, and Comstock, and Lt. Col. Gillespie.)

Convened at New York Oct. 1, 1891, by S. O. No. 66, to report upon improvement of the Hudson River. Report, **92**, 752. (Lt. Col. Gillespie and Majs. Stickney and Raymond.)

## HUDSON RIVER, N. Y.—Continued.

### Part A.—Hudson River, Troy to New Baltimore, N. Y.—Continued.

ENGINEERS IN CHARGE:

Capt. H. Brewerton, 1834; **66**, iii, 21, iv, 211, 212.

Capt. G. W. Hughes, 1834; **66**, iv, 212.

Maj. R. Delafield, 1852; **66**, iii, 20. Report, **66**, iv, 208.

Col. J. D. Graham, 1865. Report, **66**, 37, 40.

Lt. Col. J. Newton, 1866–84; **66**, ii, 28, 41, iii, 20. Reports, **66**, iv, 202, 206–221; **67**, 441; **68**, 711; **69**, 381; **70**, 427; **71**, 719; **72**, 797; **73**, 930; **74**, ii, 154; **75**, ii, 195; **76**, 235; **78**, 411; **79**, 367; (Col.) **80**, 471, 488, 489; **81**, 617; **82**, 641; **83**, 529; **85**, 678.

Capt. J. Mercur, 1877, in temporary charge, 1884–85. Reports, **77**, 223; **84**, 696.

Lt. Col. W. McFarland, 1885–89. Reports, **85**, 677, 690; **86**, 665; **87**, 650; **88**, 588.

Lt. Col. G. L. Gillespie, 1889–96. Reports, **89**, 756; **90**, 688, 766, 768; **91**, 864; **92**, 734; **93**, 1006; **94**, 723; **95**, 898; (Col.) **96**, 823.

Lt. Col. W. Ludlow, 1897. Report, **97**, 996.

Maj. A. M. Miller, 1898. Report, **98**, 1047.

Col. J. W. Barlow, 1899–. Reports, **99**, 1293; **1900**, 1487.

ASSISTANTS:

Capt. J. M. Wilson, **66**, ii, 41, iii, 20, iv, 206; **67**, 43; **68**, 64, 72; **69**, 54, 384. Report, **70**, 430.

Capt. S. M. Mansfield, **71**, 81.

R. H. Talcott, **69**, 384; **76**, 236.

Lt. J. H. Willard, **72**, 798; **73**, 930. Reports, **73**, 933, 934; **74**, ii, 156; **75**, ii, 195; **76**, 235; **77**, 223; **78**, 411; **79**, 370; **80**, 475; **85**, 696.

**Estimates.** (See *Projects.*)

By Board of Engineers, 1834, system of longitudinal dikes and occasional dams, $819,634.10, **66**, iv, 211, 212.

By Maj. Delafield, 1852, dredging, etc., $50,000, **66**, 3, iii, 20, 21.

By Lt. Col. J. Newton, 1866, dikes, dredging, revetments, etc., $862,297.75, **66**, iii, 21, iv, 218, 219.

By Lt. Col. Newton, 1867, completion, $474,109.75, **67**, 442. Revised in 1868 to $511,116.47, **68**, 718, 719.

By Lt. Col. Newton, 1879, completion of existing project, $65,016.47, **79**, 369.

**Obstructions.**

Complaints by Albany State Board of Pilots as to illegal dumping in the river, **90**, 690, 770.

List of bridges across the Hudson River, **90**, 692; **91**, 867; **92**, 737; **95**, 902; **96**, 828; **97**, 1010.

List of bridges authorized by State and Congressional legislation, **95**, 902; **96**, 828.

**Operations.**[a]

**1834.** Construction of dikes, dams, and revetments, **66**, iv, 212.

**1854.** Dredging at Ninemile Tree Bar and Mulls Plat Bar, **66**, iv, 212.

**1866–67.** Repairing dikes, **66**, iv, 212, 218. Dikes repaired, **67**, 43, 441.

**1867–68.** Construction and repairs of dikes and revetments; paving shore line, and dredging, **68**, 64, 65, 713–715.

**1868–69.** Construction and repairs of dikes, and dredging, **69**, 54, 381–384.

**1869–70.** Construction and repairs of dikes; dredging, and revetment built, **70**, 72, 427, 430.

**1870–71.** Construction of dikes and revetments; dredging; removal of part of Overslaugh Rock and old State dam; repairs, **71**, 82, 719–722.

**1871–72.** Construction and repairs of dikes; dredging, and removal of part of Overslaugh Rock by blasting, **72**, 798–801.

**1872–73.** Construction of 3,047 l. f. of dike; repairs, **73**, 84, 930–934.

**1873–74.** 35,028 l. f. of dike nearly completed; repairs, **74**, 94, ii, 154, 155.

**1874–75.** Construction, raising, and repairing dikes, **75**, 100, ii, 195, 196.

**1875–76.** Construction and repairs of dikes, and dredging, **76**, 54, 236, 237.

**1876–77.** Construction and repairs of dikes, and dredging, **77**, 49, 224, 225.

**1877–78.** Construction and repairs of dikes, and dredging, under State appropriation, **78**, 54, 411.

**1878–79.** Repairs; construction of dikes and piling; wreck removed, and dredging, **79**, 60, 367, 372.

**1879–80.** Dikes at Douws Point and Shad Island completed; east and west dikes at New Baltimore extended; upper section of dike between Barren Island and New Baltimore raised to h. w. level; beacon crib built; 17,000 l. f. single pile dike constructed; repairs to crib dike at Hillhouse Island to west dike at Coeymans; 9,000 c. y. dredged, **80**, 471, 472, 473, 477.

**1880–81.** Line of single piling at Staats extended 225 f.; repairs to dikes at Bath and Douws Point; 9,348 c. y. rubblestone placed; 1,170 l. f. piling restored, **81**, 618.

**1881–82.** Removal of Austins Rock commenced; dike construction under contract of 1881 nearly finished; repairs and filling to existing works, **82**, 642.

**1882–83.** Removal of Austins Rock continued; 711 l. f. dike built; 115 l. f.

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[a] History of, from 1797 to 1866, **66**, iv, 211, 220.

## HUDSON RIVER, N. Y.—Continued.

### Part A.—Hudson River, Troy to New Baltimore, N. Y.—Continued.

crib work built; repairs to high dike at Hillhouse, **83**, 529, 530.

**1883–84.** Removal of Austins Rock nearly finished; 119,760 c. y. dredged by State authorities, **84**, 696.

**1886–87.** Repair of dikes at New Baltimore, Roah Hook, and Coeymans, **87**, 654.

**1887–88.** Repairs to west dike, New Baltimore, and middle dike at Coeymans, **88**, 590.

**1889–90.** 23,582 c. y. stone used in repair of dikes, **90**, 694.

**1890–91.** 18,112 c. y. stone used in dike construction and repair; 65,000 c. y. dredged, **91**, 870, 871.

**1891–92**. Mulls Plaat Dike extended 800 f.; Mulls Dike extended 2,535 f.; Ninemile Tree Dike completed to a length of 1,735 f.; 5,600 c. y. stone, 5,213 l. f. pine piling, and 6,974 f., B. M., of square timber used in repairs to existing dikes; 52,327 c. y. dredged at Mulls Cross Over, Kellogg, Weslington, Overslaugh, New Baltimore, and Stone Light bars; 1,372 c. y. rock removed at Dettinger and Overslaugh rocks, **92**, 739, 743.

**1892–93.** Two new dikes under construction, 8 dikes repaired, 54,458 c. y. dredged, **93**, 1012; 3 wrecks removed 2,340 c. y. rock blasted and removed, 109 t. rock removed, and also 14 t. sand covering, and model of the river for World's Fair under construction, **93**, 1010–1015.

**1893–94.** 10,592 l. f. new dikes constructed, 1,000 l. f. old dikes repaired, 544,520 c. y. dredged, 13,092 t. rock and 2,259 t. sand removed, and 2 wrecks also removed, **94**, 729–731.

**1894–95.** 8,556 l. f. new dikes built 10,020 l. f. old dikes repaired, 1,125,954 c. y. dredged, 32,700 t. rock and 6,586 t. sand covering removed, 2,151 s. y. dike paved, and 1 wreck removed, **95**, 904–906.

**1895–96.** 15,808 l. f. new dikes built, 4,086 l. f. old dikes repaired, 833,796 c. y. dredged, 41,206 t. rock and 2,890 t. sand covering removed, 18,107 s. y. dike paved, and two wrecks removed, **96**, 830–832.

**1896–97.** 1,285 l. f. new dikes built and materials for repair of old dikes supplied, 1,066,875 c. y. dredged, 57,032 t. rock and 3,587 t. sand covering removed, and 3 wrecks removed, **97**, 1002–1003.

**1897–98.** 2,254 l. f. new dikes built, 2,094 l. f. old dikes repaired, 8,743 l. f. refilled with rubblestone, and stone for paving 5,404 s. y. of old dikes and revetments furnished, 530,483 c. y. dredged, 45,916 t. rock and 4,779 t. sand covering removed, and 3 wrecks also removed, **98**, 1049–1051.

**1898–99.** New dike under construction; 1,261 c. y. rubblestone and 800 c. y. paving stone placed in repair of old dikes, **99**, 1294.

**1899–1900.** New dike completed; 25 c. y. rubblestone and 651 c. y. paving stone placed in repair of old dikes, 177,718 c. y. dredged, and several snags and a submerged pontoon removed from channel, **1900**, 1488–1489.

**Physical characteristics.**

Freshets and ice gorges, **66**, iv, 208.

Mean flow and fall of tides, **66**, iv, 207.

Velocity of currents at low water, **66**, iv, 207.

General discussion, **66**, iv, 207, 208, 209, 213, 214.

Relative heights of tides and freshets, **68**, 716.

Effects of tides and freshets, **75**, ii, 196.

Tidal rise of the Hudson at various points, **86**, 667, 668; **87**, 652.

Drainage area of the Hudson River; greatest, least, and average rainfall from 1827 to 1890; mean rise and fall of tides at various points along the river; elevation of mean tide at Albany above that of the Atlantic Ocean; heights of greatest known freshets above plane of m. l. w. at Albany, **90**, 691; **91**, 866; **97**, 998.

Rainfall observations, **93**, 1008, 1009; **94**, 726; **95**, 900; **96**, 826; **97**, 999; **98**, 1052.

Navigation of the river at low stages dependent in a large degree upon the tidal prism of the stream, **93**, 1008.

Tidal observations, **93**, 1009; **94**, 727; **95**, 901, **96**, 826; **97**, 998; **98**, 1052; **99**, 1295.

Effects of ice formation, **93**, 1015; **94**, 732; **95**, 907; **96**, 834.

Shoal formations, **93**, 1015; **94**, 732; **95**, 907, 908; **98**, 1052.

Channel dimensions, **95**, 907; **96**, 834, 835; **97**, 1005; **98**, 1053, **99**, 1296.

Tide tables, **99**, 1295; **1900**, 1490.

Soundings tables, **99**, 1296; **1900**, 1491.

**Plans.**

By Mr. Genet, for a ship canal from Albany to deep water below, **66**, iv, 211, 212.

**Private (State) work.**

The State of New York expended for improvements between Waterford and New Baltimore, as follows: 1797 to 1866, $600,030.84, **66**, iv, 211, 212, 220. 1870–71, repairs on dike, $716.84, **71**, 719. 1872, extension and repairs of dikes and dredging, $50,000, **73**, 932. 1873, repairs of dike and dredging, $50,000, **73**, 932. 1876, dredging 136,709 c. y., $40,000, **76**, 236; **77**, 49, 225. 1877, dredging, $15,000, **77**,

**HUDSON RIVER, N. Y.**—Continued.

**Part A.—Hudson River, Troy to New Baltimore, N. Y.**—Continued.

225. 1878, dredging, $30,000, **79**, 373. 1879, dredging, $30,000, **79**, 373.

The State of New York lost by injudicious application of appropriations, $215,707, **66**, iv, 220.

Repairs to State dikes below Castleton and at Mulls Island, by State authorities, also dredging at the above places, and between Troy and Albany, **83**, 530.

Dredging by State authorities, **84**, 696; **87**, 654.

Description of work done by the State of New York, **93**, 1008.

In 1895 the disposition of the New York legislature was to leave the improvement of the river solely to the General Government, **95**, 900.

**Projects.** (See *Estimates.*)

By De Witt Clinton, 1831, dikes and dams, **66**, iv, 211, 212.

By Board of Engineers, 1834, system of longitudinal dikes and occasional dams; estimate, $819,634.10, **66**, iii, 20, iv, 206, 207, 212, 213.

By Maj. Delafield, 1852, dredging and closing island chutes, **66**, iii, 20, 21, iv, 208, 209.

The original and revised projects, under which the present works for the improvement of the river are conducted, were proposed by Col. Newton in 1866 and 1867, and provide for securing a navigable channel 11 f. deep at m. l. w. from New Baltimore up to Albany, and 9 f. deep at m. l. w. from Albany up to Troy. This project in detail is as follows: First, a system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear; these dikes to be brought gradually nearer together from New Baltimore toward Troy; second, dredging where necessary; third, keeping the side reservoirs open to the passage of tidal currents, by gaps at their lower extremities, in order to increase the tidal flow; fourth, constructing dikes of timber and stone. The original estimated cost of this improvement was $862,297.75; this estimate was increased several times at later periods, to take account of expenditures for repairs and for work done not included in previous estimates; it was revised in 1867 to $984,304.47, **68**, 718, 719; **87**, 667. Increased in 1882, to cover repairs, by $78,000, **82**, 643; **86**, 667. For removal of rock, 1884, by Capt. Mercur, $16,000, **84**, 696. Increasing the estimated cost to $1,078,304.47, **86**, 667; **87**, 651, 656.

From 1864 to 1886, inclusive, $1,053,538 was appropriated.

In 1887, Lt. Col. McFarland considered that $255,000 would yet be required to complete the permanent works and make needed repairs to existing dikes, **87**, 653, 655, 656.

In 1889 this estimate was increased to $295,000 over and above prior appropriations, **89**, 760.

By Board of Engineers, 1891, for excavation of a channel 12 f. deep and 400 f. wide from Coxsackie to the foot of Broadway, Troy, and thence 12 f. deep and 300 f. wide to the State Dam at Troy; estimate, $2,447,906.56, **92**, 752, 759.

In 1898, Maj. Miller estimated it would cost $2,246,769.80 additional to complete the existing project, and $100,000 annually for maintenance, **98**, 1054.

**Surveys.**

1819–52. **67**, 446.

By De Witt Clinton, 1831, **66**, iv, 207, 211.

By Capt. Hughes, 1843, **66**, iv, 212.

By Maj. Delafield, 1852, **66**, iv, 208.

Under direction of Lt. Col. Newton, by R. H. Talcott, 1867–68–69, between Troy and New Baltimore, and from Troy to Albany, **67**, 441; **68**, 65, 711; **69**, 384.

Under direction of Lt. Col. Newton, by F. Von Egloffstein and R. H. Talcott, 1872, **72**, 801; **76**, 235, 236; **77**, 49, 223.

Under direction of Lt. Col. Newton, by Lt. Willard, 1878, from Troy to south end of Houghtailing Island, **78**, 54, 411.

Under direction of Lt. Col. Newton, by Lt. Willard, 1879, of various parts of the river, **79**, 60, 370.

Examination of rocks at Van Wies Point; surveys and examinations at various points, **80**, 475.

Of river between Troy and New Baltimore, by Lt. Col. McFarland, 1884, **85**, 695.

Between New Baltimore and Coxsackie, ordered by act of Aug. 5, 1886, **87**, 97.

Miscellaneous surveys, examinations, etc., **93**, 1015; **94**, 731, 732; **95**, 906; **96**, 833; **97**, 1004; **98**, 1052; **99**, 1295; **1900**, 1491.

**Maps.**

Of a portion of the river near Castleton, **66**, i.

**80**, 484; **81**, 618; **85**, 692, 696.

## HUDSON RIVER, N. Y.—Continued.

### Part B.—Hudson River (Jersey City).

**Appropriation.**
1875, $25,000, **75**, 101, ii, 215; **77**, 245.

**Contract.**
**1875.** Curtis, Fobes & Co., dredging, 12½ cents per c. y., **76**, 243, 244.

**Engineers.**
Chief of Engineers. Reports, **75**, 101; **76**, 55; **77**, 50.

Engineers in Charge:
Lt. Col. John Newton, 1875–77. Reports, **75**, ii, 215; **76**, 243; **77**, 245, 246.
Capt. J. Mercur, in temporary charge, 1877. Report, **77**, 245.

Assistant. J. H. Striedinger, **75**, ii, 219.

**Estimates.** (See *Projects.*)
By Lt. Col. Newton, dredging in the vicinity of Pavonia Ferry and Cunard docks, $101,807.20, **75**, ii, 219; **76**, 244; **77**, 245.

**Operations.**
**1876.** 105,924 c. y. removed; dredging under contract, and 57,715 c. y. by hired labor from vicinity of Jersey Ferry slips and Cunard docks, **76**, 55, 243.
**1877.** Dredging suspended, **77**, 247.

**Physical characteristics.**
Discussed, **75**, ii, 216–219; **77**, 246.

**Private and corporate work.**
Dredging by several railroad and steamship companies in 1874, at a cost of $116,737.95, **75**, ii, 217.

**Projects.** (See *Estimates.*)
By Lt. Col. Newton, 1875, dredging 221,300 c. y. from Pavonia Ferry to Cunard docks, **75**, ii, 219. Dredging to the amount of the appropriation, **75**, ii, 215.

**Secretary of War.**
Approves the views of Chief of Engineers that dredging be suspended, **77**, 247.

**Surveys.**
Under direction of Lt. Col. Newton, by J. H. Striedinger, Preuss, and De Foresta, 1874. Report, **75**, ii, 215.
Resurvey under direction of Lt. Col. Newton, 1877, **77**, 246.
Maps. Of survey by Maueer and Sylvester, **75**, ii, 219.

### Part C.—Hudson River, N. Y. (Including Ellis Island to Constable Hook, N. J.; in front of Jersey City and Hoboken; and Weehawken to Bergen Point, N. J.).

**Commerce.**
Importance, **81**, 720; **84**, 776.

**Engineers.**
Chief of Engineers. Reports, **82**, 116; **84**, 122; **85**, 115.
Engineer in Charge. Maj. G. L. Gillespie, 1882–85. Reports, **82**, 719; **84**, 774; **85**, 790, 791.
Assistant. A. Doerflinger. Report, **82**, 722.

**Physical characteristics.**
Description of localities, **81**, 719.
Deposits from dumping on Jersey Flats, **82**, 720.
Comparison of surveys in front of Jersey City, **84**, 779.

**Plans.**
By Maj. Gillespie, 1882, formation of a channel 300 f. wide and 21 f. deep at low water from the wharves of the Central R. R. of New Jersey to deep water in Kill von Kull, by rock removal and dredging; estimate $7,134,980, **82**, 721, 724; **85**, 793.
By Maj. Gillespie, 1884, obtaining a deep-water front along Jersey City and Hoboken by the advance of the pier-head line from Castle Point to Communipaw, **84**, 777, 780. Extension of line farther up stream suggested, **85**, 793.
By Maj. Gillespie, 1885, improvement of Kill von Kull by the removal of the rocky ledges outside of the exterior wharf lines to a depth of 10 f. at low water; estimate $1,090,000, **85**, 795.

**Surveys.**
From Ellis Island to Constable Hook, ordered by act of Mar. 3, 1881, made under direction of Maj. Gillespie, **82**, 719.
Of North River in front of New Jersey, ordered by act of Aug. 2, 1882, made under direction of Maj. Gillespie, **84**, 774.
From Weehawken to Bergen Point, ordered by act of July 5, 1884, made under the direction of Maj. Gillespie, 1884, **85**, 790.

Maps.
North River from Ellis Island to Fort Washington Point, **85**, 792.
Upper New York Bay from Ellis Island to Bergen Point, **85**, 792.

### HUDSON RIVER, N. Y.—Continued.

### Part D.—Hudson River, N. Y. (Troy to mouth of canal).

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 96.
ENGINEER IN CHARGE. Capt. J. Mercur. Report, **85**, 71.
ASSISTANT. F. P. Rogers. Report, **85**, 712.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Capt. Mercur (report unfavorable), **85**, 711, 712.

### Part E.—Hudson River, N. Y. (Coxsackie to New Baltimore).

**Engineers.**
CHIEF OF ENGINEERS. Report, **88**, 68.
ENGINEERS IN CHARGE:
Lt. Col. W. McFarland, 1887. Report, **88**, 640.
Lt. Col. G. L. Gillespie, 1888. Reports, **88**, 641; **91**, 864.
ASSISTANT. M. Kingsley. Report, **88**, 642.

**Physical characteristics.**
Description of, **88**, 640.

**Projects.**
Inasmuch as a sufficient depth already exists between New Baltimore and Coxsackie, Lt. Col. Gillespie did not consider further improvement necessary, **88**, 642.

**Survey.**
Ordered by act of Aug. 5, 1886, made, 1888, under direction of Lt. Col. Gillespie (report unfavorable) (see *Projects*), **88**, 641.
MAPS. **88**, 642.

### HULL, MASS. (See *Boston Harbor.*)

### HULL, MASS. (Headland).

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 78.
ENGINEERS IN CHARGE:
Col. G. Thom. Report, **84**, 552.
Maj. C. W. Raymond. Report, **84**, 553.
ASSISTANT. H. F. Bothfield. Report, **84**, 554.

**Plans.**
By Maj. Raymond, protecting headland in the town of Hull, at the entrance to Boston Harbor, by sea wall; estimate $181,000, **84**, 553, 557.

**Survey.**
Ordered by act of Aug. 2, 1882, made under direction of Maj. Raymond (report unfavorable), **84**, 522.

### HULLS CREEK, VA.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **84**, 163; **89**, 134.
ENGINEER IN CHARGE. S. T. Abert, U. S. agent, 1884–88. Reports, **84**, 1004; **89**, 1025.

**Physical characteristics.**
Description of, **84**, 1004; **89**, 1026.

**Plans.**
In 1883 S. T. Abert considered that the improvement of Hulls Creek was not a public necessity, **84**, 1004.
In 1888 Mr. S. T. Abert did not consider Hulls Creek as worthy of improvement, **89**, 1027.

**Surveys.**
Examination ordered by act of Aug. 2, 1882, made under direction of S. T. Abert (report unfavorable), **84**, 1004.
Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of S. T. Abert (report unfavorable), **89**, 1025.

### HUMBOLDT BAY, CAL. (See *Eureka Harbor, Cal.; Pacific Coast, Harbor of Refuge.*)

**Appropriations.**
1881, $40,000, **81**, 2481.
1882, 40,000, **82**, 2540.
1884, 62,500, **84**, 2200.
1886, [a]75,000, **86**, 1921.
1888, 125,000, **88**, 2135.
1890, 80,000, **90**, 2921.
1892, 150,000, **92**, 2659.
1893, 522,000, **93**, 3281.

**Appropriations**—Continued.
1895, 225,000, **95**, 3317.
1896, 225,000, **96**, 3211.
1897, 350,000, **97**, 3367.
1898, 100,000, **98**, 2950.
1899, 193,115, **99**, 3186.

Total, 2,187,615

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[a] See proviso of act of 1866, **87**, 2447.

## HUMBOLDT BAY, CAL.—Continued.

**Commerce.**

Anticipated benefit of improvement, **83**, 1985.

Freight and passenger travel to be influenced by improvement, **91**, 3124.

The bulk of the commerce seeking the harbor goes to Eureka, **97**, 3378.

**Contracts.**

**1881.** W. B. English, dredging, 34 cents per c. y., **81**, 2481.

**1882.** J. Hackett, dredging, 25 cents per c. y., **83**, 1984.

**1884.** W. B. English, dredging, 48 cents per c. y., **84**, 2200.

**1888.** American Bridge & Building Co., training wall construction, $171,350, **89**, 2490.

**1891.** Simpson & Brown, jetty construction, $157,950, **91**, 3121.

**1892.** J. C. Bull, jetty construction, approximate total of bid, $740,660. Single track, $2.50 per f.; double, $5 per f. Trestle with double track, $8 per f. Brush mats in place, $1.34 per c. y. Rock, $1.34 per ton. Single track on south jetty, $2.50 per f. Moving old track, 30 cents per f. **93**, 3279. (Continuous contract.)

**1899.** W. N. Concanon, dredging, 12.36 cents per c. y. ($50,000), **1900**, 4246.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **77**, 123; **78**, 136; **79**, 180; **80**, 236; **81**, 323; **82**, 317; **83**, 330; **84**, 333; **85**, 361; **86**, 353; **87**, 323; **88**, 296; **89**, 351; **90**, 316; **91**, 397, 427; **92**, 373; **93**, 429; **94**, 401; **95**, 439; **96**, 391; **97**, 492, 494; **98**, 477; **99**, 559; **1900**, 632.

BOARDS OF ENGINEERS.

Of the Pacific coast, met Aug., 1876, to examine the harbors of Mendocino, Humboldt Bay, Trinidad, and Crescent City, Cal., with a view of establishing a harbor of refuge. The Board of Engineers did not deem it necessary to make any plan or estimate, as they considered it almost impossible to build a breakwater or jetties at this place. Reports, **77**, 1052; **79**, 1785. (Lt. Cols. R. S. Williamson, B. S. Alexander, and C. S. Stewart, and Maj. G. H. Mendell.)

Convened at San Francisco, Cal., Oct. 13, 1882, to report upon improvement of Humboldt Bay, **83**, 1992. (Col. Stewart, Lt. Cols. Mendell, Craighill, and Comstock, and Capt. Powell.)

Convened at San Francisco Mar. 13, 1891, by S. O. No. 72, to consider and report upon project for improvement of Humboldt Bay. Report, **91**, 3129. (Col. Mendell, Lt. Col. Benyaurd, and Maj. Heuer.)

Convened at San Francisco June 8, 1891, by S. O. No. 55, to report upon establishment of harbor lines in Humboldt Bay. Report, **91**, 3141. (Col. Mendell, Lt. Col. Benyaurd, and Maj. Heuer.)

Board of Engineers of 1890 reconvened Dec. 16, 1892, to consider and report upon change suggested by Maj. Heuer in project for improvement of Humboldt Harbor. Report, **93**, 3288.

ENGINEERS IN CHARGE:

Lt. Col. B. S. Alexander, 1878. Report, **79**, 1786.

Lt. Col. G. H. Mendell, 1880–85. Reports, **81**, 2480, 2481; **82**, 2539; **83**, 1983, 1986; **84**, 2199.

Capt. A. H. Payson, 1885–87. Reports, **85**, 2351; **86**, 1919; **87**, 2447.

Maj. W. H. Heuer, 1888–95; 1898–. Reports, **88**, 2135; **89**, 2490; **90**, 2918; **91**, 3120, 3138, 3140; **92**, 2656; **93**, 3278; **94**, 2540; **95**, 3310; **98**, 2948; **99**, 3185; (Lt. Col.), **1900**, 4237.

Capt. C. E. Gillette, 1896–97. Reports, **96**, 3207; **97**, 3366, 3377.

ASSISTANTS:

A. Boschke. Reports, **82**, 2540; **83**, 1984; **84**, 2200.

Lt. H. Deakyne. Reports, **94**, 2543; **95**, 3317; **96**, 3211.

Lt. J. J. Meyler. Report, **97**, 3369.

D. E. Hughes. Report, **98**, 2951.

**Operations.**

**1881–83.** 95,744 c. y. dredged from Eureka and Arcata channels; protection from erosion of north spit by brush jetties, **82**, 2539, 2541.

**1882–83.** 75,904 c. y. dredged from Arcata, Hookton, and Eureka channels, **83**, 1984.

**1883–84.** 26,080 c. y. dredged from Eureka Channel, **84**, 2200.

**1888–89.** 1,152 l. f. shore protection built, containing 1,672 c. y. brush and 2,748 t. rock, **89**, 2491.

**1889–90.** 24,512 t. rock and 14,669 c. y. brush delivered in the jetty, and 2,767 l. f. of pier built, **90**, 2919.

**1890–91.** 8,168 t. of rock placed in the jetty; wharf and approaches built on north spit, **91**, 3122.

**1891–92.** 300 l. f. of brush and stone shore protection built at north spit; 8,777 c. y. brush mattress and 15,930 t. stone placed in north jetty; 4,759 c. y. brush mattress and 30,778 t. stone placed in south jetty; 1,486 l. f. track way laid in stone, and trestle and track over the water extended 1,480 f. **92**, 2658.

**1892–93.** Repairs made to north spit protection work, **93**, 3278; and north jetty extended to a length of 2,293 f., **93**, 3280.

## HUMBOLDT BAY, CAL.—Continued.

**1893–94.** North jetty extended to a length of 5,178 f., and spurs built at south jetty to prevent encroachment of channel, **94**, 2542.

**1894–95.** Extension of south jetty in progress, and maintenance of jetty carried on, **95**, 3312, 3313; north jetty completed for a distance of 6,329 f., **95**, 3316. (Summary of construction work by months on north and south jetties for the year, **95**, 3316.)

**1895–96.** North jetty work carried to about 8,100 f., and various repairs made, **96**, 3209, 3210; work on south jetty carried to about 5,000 f., and various repairs made to it, **96**, 3210.

**1896–97.** North jetty completed; portions of south jetty rebuilt, **97**, 3366, and south jetty work carried to about 5,500 f. from shore, **97**, 3367.

**1897–98.** 67,755 t. of stone placed in south jetty for its extension, **98**, 2949.

**1898–99.** 228,211 t. rock placed in south jetty, **98**, 3185.

**1899–1900.** 26,179 t. stone placed in south jetty; 8,733 t. placed in north jetty (brief history of jetty work—rock and brush delivery, method of building jetties, etc.); 387,265 c. y. dredged, **1900**, 4237–4243.

**Physical characteristics.**

Description of, **81**, 2482; **83**, 1987; **91**, 3129; **93**, 3279; **95**, 3317; **97**, 3377; **1900**, 4238.

**Projects.**

By Lt. Col. Mendell, 1881, securing, by dredging, a channel 13 f. deep and 200 f. wide to the upper end of Eureka wharves, with channel 100 f. wide and 10 f. deep to Arcata and Hookton; estimate, $135,220, **81**, 2480, 2485.

In 1882, after the appropriation of $80,000, Lt. Col. Mendell proposed to obtain an increased depth of channel across the outer bar by a training wall about 6,000 f. long from the south spit, running in a northerly direction; estimate, $600,000, **83**, 1991. Approved by the Board of Engineers of 1882, **83**, 1992; **87**, 2447.

In 1890 the existing project was modified to embrace shore-protection work on the north spit, and the construction of a jetty starting from there and running seaward nearly parallel to the jetty on the south spit, both jetties to extend out to the 18-f. contour, and be raised to the plane of high water; estimate for completing project, $1,715,115, **91**, 3121; **92**, 2658.

By Board of Engineers, 1892, modification of existing project to provide for relocation of the north jetty in such a way as to utilize the shore protection built on the north side of the entrance and make it a part of the proposed north jetty; also its construction out to a point sufficient to arrest erosion before the completion of the south jetty, after which both jetties were to be carried out simultaneously to the 18-f. curve, **93**, 3278, 3289.

The Chief of Engineers, 1898, estimated it would cost $75,000 to improve the harbor by dredging at Eureka, **98**, 2958.

By Maj. Heuer, dredging a 15-f. low-water channel 8,900 f. long in front of the city wharves at Eureka, 200 f. wide, **99**, 3185; **1900**, 4237.

Sections of completed jetties, **1900**, 4243.

**Surveys.**

Examination by Board of Engineers. Report, **77**, 1052. Examination ordered by act or June 18, 1878, assigned to Lt. Col. Alexander, **78**, 136. Report, **79**, 1785.

Ordered by act of June 14, 1880, made 1880, under direction of Lt. Col. Mendell, **81**, 2481.

Survey made, 1894, by Maj. Heuer, **95**, 3317.

A complete survey of the entrance to the bay was made in 1895–96, by Capt. Gillette, and also in 1897, **96**, 3210; **97**, 3367; and a survey of the Eureka water front was made in 1895–96 by the same officer to ascertain the extent of the shoaling of the channel, **96**, 3211.

Examination with a view to dredging along the city (Eureka) front ordered by act of June 3, 1896, made, 1897, by Capt. Gillette (report favorable), **97**, 3377.

A complete survey of the entrance to the bay was made in 1897–98 by Maj. Heuer, **98**, 2949.

Survey of the entrance made by Maj. Heuer, 1898–99 (maps), **99**, 3185.

Maps. **91**, 3122, 3131; **95**, 3324; **96**, 3218; **97**, 3368; **98**, 2954, **99**, 3186, **1900**, 4246.

## HUMPTULIPS RIVER, WASH.

**Engineers.**

Chief of Engineers. Report, **84**, 342.

Engineer in Charge. Capt. C. F. Powell. Report, **84**, 2294.

**Physical characteristics.**

River described, **84**, 2295.

**Survey.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Powell (report unfavorable), **84**, 2294.

## HUNTERS CREEK, VA.

**Engineers.**
Chief of Engineers. Report, **87**, 114.
Engineer in Charge. S. T. Abert, U. S. agent, 1886. Report, **87**, 962.

**Survey.**
Examination ordered by act Aug. 5, 1886, but S. T. Abert unable to discover any such creek, **87**, 962.

## HUNTING CREEK, VA.

**Commerce.**
Description of, **95**, 1157, 1158.

**Engineers.**
Chief of Engineers. Report, **84**, 151; **89**, 134; **95**, 151.

Engineers in Charge:
Capt. T. Turtle. Report, **84**, 961.
S. T. Abert, U. S. agent, 1888. Report, **89**, 1028.
Maj. W. F. Smith, U. S. agent, 1895. Report, **95**, 1156.

Assistants:
J. L. Seager. Report, **84**, 961.
A. Stierle. Report, **95**, 1157.

**Physical characteristics.**
Description of, **95**, 1157.

**Plans.**
In 1882 Capt. Turtle did not consider the work a public necessity, **84**, 961.
In 1888 S. T. Abert did not consider that existing commercial necessities warranted the improvement of Hunting Creek, **89**, 1028.

**Surveys.**
Examination ordered by act of Aug. 2, 1882, made under the direction of Capt. Turtle. (See *Plans.*) **84**, 961.
Examination ordered by act of Aug. 11, 1888, made, 188, under direction of S. T. Abert. (See *Plans.*) **89**, 1028.
Examination ordered by act of Aug. 17, 1894, made under the direction of Maj. Smith, U. S. agent, in 1894 (report unfavorable), **95**, 1156.

## HUNTINGTON HARBOR, LONG ISLAND, N. Y.

**Appropriations.**

| | | |
|---|---|---|
| 1872, | $22,500, | **72**, 84. |
| 1890, | 10,000, | **91**, 819. |
| 1892, | 5,000, | **92**, 719. |
| 1894, | 2,000, | **95**, 837. |
| 1896, | 5,000, | **96**, 740. |
| 1899, | 7,500, | **99**, 1223. |
| Total, | 52,000 | |

**Commerce.**
Important, **72**, 907; **85**, 706.

**Contracts.**
**1872.** S. F. Shelbourne, dredging, 30 and 14.98 cents per c. y., **72**, 905.
**1891.** C. & H. E. Du Bois, dredging, 15.9 cents per c. y., **91**, 819.
**1892.** E. Brainard, dredging, 19¾ cents per c. y. ($4,937.50), **93**, 977.
**1894.** J. H. Fenner, dredging, 12 cents per c. y. ($1,700), **95**, 837.
**1897.** E. Brainard, dredging, 47,368 c. y., at 9½ cents per c. y., s. m., **97**, 1102.
**1899.** Du Bois Bros. Dredging Co., dredging, 13.9 cents per c. y. ($6,741.50), **99**, 1224.

**Engineers.**
Chief of Engineers. Reports, **71**, 87; **72**, 84; **73**, 92; **85**, 96; **91**, 76; **92**, 81; **93**, 88; **94**, 79; **95**, 89; **96**, 86; **97**, 121; **98**, 116; **99**, 131; **1900**, 149.

Engineers in Charge:
Maj. G. K. Warren, 1871–85. Reports, **72**, 905; **73**, 1027; (Lt. Col.), **85**, 703, 704.
Col. D. C. Houston, 1890–92. Reports, **91**, 817; **92**, 717.
Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 975; **94**, 698; (Col.), **95**, 835.
Maj. H. M. Adams, 1896–98. Reports, **96**, 738; **97**, 1100; **98**, 1005.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1223.
Maj. E. H. Ruffner, 1900. Report, **1900**, 1397.

Assistants:
W. S. Edwards. Report, **72**, 908.
J. H. Dager. Report, **73**, 1027.

**Operations.**
**1872–73.** 91,786 c. y. dredged, **73**, 1027.
**1891–92.** 55,137 c. y. dredged, **92**, 718.
**1892–93.** 22,034 c. y. dredged, **93**, 977.
**1895–96.** 13,994 c. y., s. m., dredged, **96**, 739.
**1896–97.** 47,050 c. y., s. m., dredged, **97**, 1101.
**1899–1900.** 48,478 c. y. dredged, **1900**, 1398.

**Physical characteristics.**
Character of bed, **72**, 907; **73**, 1027.
Tides, **72**, 907; **73**, 1029.

**Projects.**
By Maj. Warren, dredging a channel at the entrance of the harbor 200 f. wide and 8 f. deep at m. l. w., and in the inner harbor, the channel to be 150 f.

## HUNTINGTON HARBOR, LONG ISLAND, N. Y.—Continued.

wide at the bottom and 8 f. deep at m. l. w.; estimate $22,780, **72**, 905, 907, 909.

By Col. McFarland, 1885, formation of a dredged channel 100 f. wide and 8 f. deep at l. w. on the bar, the widening of the channel near the wharves, and the protection of the channel by a pile revetment 1,400 f. long; estimate $32,000, **85**, 705; **91**, 817; **92**, 718.

**Surveys.**

Included in Coast Survey, 1836, **72**, 907.

By W. S. Edwards, 1871. Report, **72**, 908.

Ordered by act of July 5, 1884, made under direction of Col. McFarland, **85**, 704.

MAPS. **93**, 976.

## HUNTSDALE. (See *Missouri River.*)

## HURON HARBOR, OHIO.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1826, | $5,000.00, | **66**, iii, 33. |
| 1828, | 4,413.35, | **66**, iii, 33. |
| 1829, | 5,935.00, | **66**, iii, 33. |
| 1830, | 1,880.36, | **66**, iii, 33. |
| 1831, | 3,480.00, | **66**, iii, 33. |
| 1832, | 1,500.00, | **66**, iii, 33. |
| 1834, | 6,700.00, | **66**, iii, 33. |
| 1836, | 4,300.00, | **66**, iii, 33. |
| 1837, | 2,565.00, | **66**, iii, 33. |
| 1838, | 5,000.00, | **66**, iii, 33. |
| 1844, | 5,000.00, | **66**, iii, 33. |
| 1852, | 10,000.00, | **66**, iii, 33. |
| 1866, | 39,000.00, | **66**, iii, 33. |
| 1874, | 1,500.00, | **74**, 49. |
| 1875, | 1,000.00, | **75**, 55. |
| 1878, | 1,000.00, | **78**, 129, 1256. |
| 1880, | 3,000.00, | **80**, 2122. |
| 1881, | 3,000.00, | **81**, 2303. |
| 1882, | 2,500.00, | **82**, 2394. |
| 1884, | 7,500.00, | **84**, 2093. |
| 1886, | 3,000.00, | **86**, 1859. |
| 1888, | 6,000.00, | **88**, 1998. |
| 1890, | 16,000.00, | **90**, 2773. |
| 1892, | 15,000.00, | **92**, 2499. |
| 1894, | 10,000.00, | **95**, 3094. |
| 1896, | 8,000.00, | **96**, 2934. |
| 1899, | 25,000.00, | **99**, 3052. |
| Total, | 197,273.71 | |

**Commerce.**

Not extensive, but increasing, **96**, 2934; **97**, 3067.

Almost entirely in iron ore and coal, **1900**, 4053.

**Contracts.**

**1866.** W. H. Mott, labor, **66**, iv, 74. F. D. Ketchum, stone, spike, and timber, **66**, iv, 74. J. Loveday, iron, **66**, iv, 74.

**1867.** Brooks & Adams, timber, **67**, 142, 232, 233. Brooks & Adams, materials and labor, **68**, 149.

**1869.** W. Nicolls, materials, labor, and dredging, **70**, 174, 176; **71**, 192.

**1880.** J. Stang, pile protection construction, **81**, 2304.

**1882.** J. Stang, removal and reconstruction of old superstructure, **83**, 1900.

**1884.** L. P. & J. A. Smith, pier repairs and dredging, **85**, 2221.

**1886.** Stang & Gillmore, dredging, 25 cents per c. y., **87**, 2307. L. P. & A. J. Smith, repair to piers, **87**, 2309.

**1889.** Stang & Kerr, pier repair, $4,685.20, **89**, 2315. W. St. John & Son,

**1890.** J. Stang, for repairs to piers, dredging, 28 cents per c. y., **89**, 2313. $5,270, **91**, 2845. Carkin, Stickney & Cram, dredging, 25 cents per c. y., **91**, 2847.

**1893.** Q. Gilmore, extension of piers, approximate total of bid, $9,410.01. Sadler & Allen, dredging, 25 cents per c. y., s. m., **93**, 3069.

**1895.** J. Stang, pier extension, approximate total of bid, $6,390.86, **95**, 3095.

**Documents.** (Not printed in reports.)

All details relating to this improvement previous to 1867, S. Doc. 42, 35th Cong., 1st sess., containing report of Col. J. D. Graham, in 1857, **66**, 5.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 5, ii, 41, iii, 5, 6, 33, iv, 31; **67**, 29; **68**, 39; **69**, 37; **70**, 48; **71**, 46; **72**, 43; **73**, 43; **74**, 49; **75**, 54; **76**, 107; **77**, 113; **78**, 129; **79**, 171; **80**, 225, **81**, 307; **82**, 302; **83**, 310; **84**, 313; **85**, 337; **86**, 332; **87**, 298; **88**, 272; **89**, 324; **90**, 293; **91**, 367; **92**, 347; **93**, 398; **94**, 372; **95**, 407; **96**, 361; **97**, 455; **98**, 445; **99**, 527; **1900**, 593.

ENGINEERS IN CHARGE:

Maj. J. D. Graham, 1857. Report, S. Doc. 42, 35th Cong., 1st sess.

Col. T. J. Cram, 1866–69. Reports, **66**, iv, 30, 73; **67**, 142, 148, 230–233.

Maj. W. McFarland, 1869–71. Reports, **69**, 131; **70**, 174.

Capt. G. L. Gillespie, 1871–73. Reports, **71**, 192; **72**, 228.

Maj. F. Harwood, 1873–74; **73**, 331; **74**, 218.

Lt. Col. C. E. Blunt, 1874–76. Reports, **75**, 297; **76**, ii, 555.

Maj. N. Michler, 1876–78. Reports, **77**, 959; **78**, 1255; **79**, 1673.

Maj. J. M. Wilson, 1878–83. Reports, **79**, 1686; **80**, 2117; **81**, 2302; **82**, 2393.

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[a] Survey.—Report July 27, 1826; estimate, $15,349.12 (H. Doc. No. 482, 55th Cong., 2d sess.)

## HURON HARBOR, OHIO—Continued.

Maj. L. C. Overman, 1883–92. Reports, **83**, 1898; **84**, 2092; **85**, 2219; **86**, 1858; **87**, 2307; **88**, 1997; **89**, 2313; **90**, 2772; **91**, 2843.

Lt. Col. J. A. Smith, 1892–. Reports, **92**, 2498; **93**, 3067; **94**, 2400; **95**, 3092; **96**, 2931; (Col.), **97**, 3064; **98**, 2653; **99**, 3051; **1900**, 4051.

ASSISTANTS:

Capt. F. U. Farquhar, **66**, ii, 41, iv, 30, 31.

Capt. G. J. Lydecker, **68**, 151.

Capt. M. B. Adams, **75**, 292.

**Estimates.** (See *Projects.*)

By Maj. Graham, for improvement of harbor, $39,000; for repairs of piers, $26,782.

By Col. Cram, for annual preservation, $2,000, **68**, 149–151.

By Maj. McFarland, $1,500, **69**, 131.

By Maj. McFarland, for repairs, $2,500; for annual repairs, $1,500, **69**, 131.

By Capt. Gillespie, for annual repairs, $1,000, **71**, 193.

By Maj. Harwood, for entire and permanent completion of repairs, $2,000, **73**, 331; $1,000, **74**, 218.

By Maj. Michler, for repairs to piers, $1,000, **77**, 959.

By Maj. Wilson, for rebuilding superstructure to both piers and breakwater, $25,000, **79**, 171, 1686.

**Operations.**[a]

**1866–67.** Both piers repaired and cribs replaced; amount expended, $10,960.24, **67**, 142, 148; **68**, 40.

**1870.** Piers repaired and sand and rock removed from channel by dredging, **70**, 48; **71**, 192.

**1873–74.** Repairs to piers by day labor, **73**, 331; **74**, 49.

**1875–76.** Repairs and dredging, **75**, 298; **76**, ii, 555.

**1878–79.** Repairs to piers, **79**, 171, 1673, 1686. Partial history of operations from 1826 to 1877, **77**, 959.

**1879–80.** Repairs to piers, **80**, 2121.

**1880–81.** 219 l. f. pile protection completed; repairs to piers, **81**, 2302, 2303.

**1881–82.** 300 l. f. east pier superstructure completed; pier repairs, **82**, 2393.

**1882–83.** 250 l. f. old work removed and rebuilt; 182 l. f. superstructure removed and rebuilt; repairs to piers by hired labor, **83**, 1899.

**1884–85.** 501 c. y. dredged, 185 l. f. of west pier rebuilt and 576 l. f. repaired; 48 l. f. pile protection built and 72 l. f. repaired; repairs to piers, **85**, 2220.

**1886–87.** 4,147 c. y. dredged from bar; repair of piers in progress, **87**, 2307.

**1888–89.** Pier repair under contract begun; 1,366 c. y. dredged, **89**, 2313.

**1889–90.** Pier repair continued, **90**, 2772.

**1890–91.** 8,092 c. y. dredged; repairs to piers and extension of west pier, **91**, 2844.

**1891–92.** West pier extended 120 f.; minor repairs to superstructure of old piers, **92**, 2499.

**1892–93.** Building of cribs for the extension of the east and west piers in progress, **93**, 3068.

**1893–94.** Work of last year completed, comprising an extension of the east pier by 80 f. and of the west pier by 40 f.; repairs made to superstructure of west pier, **94**, 2401, 2402.

**1894–95.** 4,000 c. y. dredged, and extension of east pier by 72 f. in progress, **95**, 3093, 3094.

**1895–96.** Pier extension of last year completed, **96**, 2932.

**1896–97.** 188 f. of old west pier entirely removed, the site dredged, and 180 f. of new pier 16 f. wide constructed, **97**, 3065.

**1897–98.** 9,347 c. y. dredged, **98**, 2654.

**Physical characteristics.**

Description of, **93**, 3068; **96**, 2933; **97**, 3067.

Harbor so situated that the channel depths vary but little from year to year; 19-f. depth at 1900, **99**, 3051, 3053; **1900**, 4053.

**Private work.**

The Wheeling and Lake Erie Ry. Co. was given a revocable license by the Secretary of War in 1896 for the removal of a part of an old pier to enable them to construct a dock 1,200 f. long and 250 f. wide near the shore and parallel to the east side of the shore, **96**, 2933. Dredging by the company, **99**, 3051.

**Projects.**

History of the original projects, **77**, 959.

By Col. Cram, repairs to the piers; estimate, $26,782, **66**, iv, 31; **67**, 142; **68**, 149.

By Maj. McFarland, repairs to piers and dredging, **69**, 131; **70**, 174.

By Maj. Harwood, repairs and dredging, **73**, 331; **74**, 218.

By Maj. Michler, repairs to piers, **77**, 959.

By Maj. Wilson, rebuilding superstructure to both piers and breakwater at inner end of the west pier, **79**, 1686.

The project adopted in 1826 and modified in 1871 proposed the extension of 2 parallel piers 140 f. apart, the object being to afford a channel for entrance not less

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[a] No record of details prior to 1867. Suspended since 1852, **66**, 5.

## HURON HARBOR, OHIO—Continued.

than 14 f. deep, **80**, 2127; **85**, 332. Between 1826 and 1880, $101,273.71 had been appropriated, **80**, 2121.

In 1879 Maj. Wilson proposed rebuilding the superstructure to both piers and reconstruction of a short breakwater at the shore end of the west pier; estimate, $25,000, **79**, 1686; **80**, 2121. Increased in 1885 by $6,500, **85**, 2220; **87**, 2308.

By Maj. Overman, 1890, 17 f. channel depth by extension of piers to the 17-f. curve in the lake; estimated cost of extension, with necessary dredging, $40,000, **90**, 2773; **92**, 2498.

In 1892–93 Lt. Col. Smith estimated that after revising the project it would cost $125,000 to extend the piers to 16 f. depth, **93**, 3068.

By Col. Smith, 1899, application of available funds to renewal of parts of old piers, **99**, 3051. After completion of this work, it was estimated that $204,400 would be required for further work of this character, **1900**, 4053.

Col. Smith recommended, 1900, as in preceding years, and because of the increasing demand for deeper channels, that no further extensions of the piers be made under the plans and limitations of the project of 1890, **1900**, 4052.

**Surveys.**

Of harbor, 1879, **80**, 2120; 1882, **82**, 2393.

A hydrographic survey was made to cover the channel and approaches at Huron in 1892–93 by Lt. Col. Smith, **93**, 3068.

A survey of the channel was made in 1895 by Lt. Col. Smith, **95**, 3094.

Minor surveys, **1900**, 4053.

MAPS:

**66**, i; **91**, 2845; **94**, 2402; **99**, 3052.

## HURON, LAKE (Harbor of refuge on). (See *Sand Beach, Lake Huron.*)

## HURON RIVER, MICH.

**Commerce.**

Description of, **97**, 3035. In 1897 the present and prospective commerce unimportant, **97**, 3036.

**Engineers.**

CHIEF OF ENGINEERS. Report, **97**, 451.

ENGINEER IN CHARGE. Lt. Col. G. J. Lydecker, 1896–97. Report, **97**, 3034.

**Physical characteristics.**

Description of. A small stream discharging into Lake Erie at its northwest corner, **97**, 3035.

**Surveys.**

Examination of the river from its mouth to the point of crossing of the Michigan Central R. R. ordered by act of June 3, 1896, made, 1897, by Lt. Col. Lydecker (report unfavorable), **97**, 3034.

## HUTCHINSON RIVER, N. Y. (See *East Chester Creek.*)

## HYANNIS HARBOR OF REFUGE, MASS.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1827, | $10,650.00, | act Mar. 2. |
| 1830, | 6,517.82, | act Apr. 30. |
| 1831, | 8,400.00, | act Mar. 2. |
| 1832, | 7,600.00, | act July 3. |
| 1833, | 5,000.00, | act Mar. 2. |
| 1834, | 10,000.00, | act June 28. |
| 1835, | 9,000.00, | act Mar. 3. |
| 1837, | 5,000.00, | act Mar. 3. |
| 1838, | 8,764.00, | act July 7. |
| 1852, | 5,000.00, | act Aug. 30. |
| 1870, | 12,000.00, | **70**, 79; **71**, 895. |
| 1871, | 10,000.00, | **71**, 95, 895; **72**, 953. |
| 1873, | 10,000.00, | **73**, 86. |
| 1874, | 5,000.00, | **74**, 96, ii, 181; **75**, 106. |
| 1878, | 3,000.00, | **78**, 46, 226. |
| 1879, | 2,500.00, | **79**, 53, 297. |
| 1881, | 5,000.00, | **81**, 540. |
| 1886, | 10,000.00, | **86**, 586. |
| 1888, | 10,000.00, | **88**, 485. |
| 1890, | 8,000.00, | **90**, 553. |
| 1892, | 6,000.00, | **92**, 599. |
| 1894, | 3,500.00, | **95**, 657. |
| 1896, | 6,000.00, | **96**, 625. |
| 1899, | 2,162.00, | **99**, 1104. |
| Total | 169,093.82 | |

**Commerce.**

Description of, **70**, 459; **73**, 86.

**Contracts.**

**1870.** G. Clapp, repairing breakwater, $38.62 per l. f., **71**, 897.

**1871.** G. Clapp, repairing and completing breakwater, $37.50 per l. f., **71**, 897.

**1873.** Dawson, Tank & Co., granite, $4.40 per t., **73**, 949.

**1878.** J. H. White, granite, $1.97 per t., **79**, 296.

**1879.** F. Crocker, removal of wreck, $370, **79**, 296; J. H. White, granite riprap, $1.43 per t., **80**, 366.

[a] Survey—Report, 1826, estimate $10,560. (H. Doc. No. 482, 55th Cong., 2d sess.)

## HYANNIS HARBOR OF REFUGE, MASS.—Continued.

**1881.** C. E. Davis, riprap granite, $1.69 per t., **81**, 539.

**1886.** Frank Pidgeon Dredging Co., dredging, 14.9 cents per c. y., **87**, 533.

**1893.** J. H. Fenner, dredging, 16.5 cents per c. y. ($3,600), **93**, 805.

**1895.** Hartford Dredging Co., dredging, 17.3 cents per c. y. ($2,000), **95**, 657.

**1896.** Hartford Dredging Co., dredging, 21 cents per c. y., **97**, 885.

**Documents.** (Not printed in reports.)

Report of Lt. Col. C. E. Blunt, 1852, **73**, 948; report of Maj. Warren, 1873, **73**, 947; report on importance of early removal of a wreck, **79**, 296.

**Engineers.**

Chief of Engineers. Reports, **66**, 7; **70**, 79; **71**, 95; **72**, 94; **73**, 86; **74**, 96; **75**, 106; **76**, 48; **77**, 42; **78**, 46; **79**, 52; **80**, 72; **81**, 77; **82**, 77; **83**, 72; **84**, 79; **85**, 68; **86**, 68; **87**, 31; **88**, 33; **89**, 44; **90**, 38; **91**, 48; **92**, 52; **93**, 53; **94**, 50; **95**, 55, 72; **96**, 55; **97**, 66; **98**, 70; **99**, 82, 97; **1900**, 96, 111.

Engineers in Charge:

Col. J. D. Graham, 1865. Report, **66**, 41.

Maj. D. C. Houston, 1869. Report, **70**, 459.

Lt. Col. J. G. Foster, 1870. Report, **70**, 467.

Lt. Col. G. Thom, 1871–73. Reports, **71**, 895; **72**, 952.

Maj. G. K. Warren, 1873–83. Reports, **73**, 947; **74**, ii, 180; **75**, ii, 266; **76**, 203; **77**, 193, 194; **78**, 225; **79**, 295; (Lt. Col.), **80**, 365; **81**, 539; **82**, 548.

Lt. Col. G. H. Elliot, 1883–87. Reports, **83**, 467; **84**, 591; **85**, 560, 619; **86**, 585.

Maj. W. R. Livermore, 1887–92. Reports, **87**, 532; **88**, 484; **89**, 606; **90**, 552; **91**, 694.

Capt. W. H. Bixby, 1892–95. Reports, **92**, 598; **93**, 804; **94**, 571; **95**, 654, 744.

Maj. D. W. Lockwood, 1896–. Reports, **96**, 624; **97**, 884; **98**, 896; **99**, 1104; **1900**, 1234, 1284, 1286.

Assistant. P. M. Blake. Report, **74**, ii, 181.

**Estimates.** (See *Projects.*)

By Maj. Houston, 1870, completion of the work, $93,000, **70**, 460.

By Lt. Col. Thom, 1871, completion of the work, $10,000, **71**, 95; **72**, 94, 952.

By Maj. Warren, 1873, increasing the width of the base of the breakwater, $25,000, **73**, 86, 948, 949.

By Maj. Warren, 1879, completion of existing project, $5,000, **79**, 297.

**Operations.**[a]

**1870–71.** 300 l. f. breakwater rebuilt, **71**, 95, 895.

**1871–72.** 258 l. f. breakwater rebuilt, **72**, 94, 953.

**1872–73.** Repairs in progress, **73**, 86, 949.

**1873–74.** 220 l. f. breakwater rebuilt, **74**, 96, ii, 180.

**1874–75.** 1,450 t. riprap placed, on the outside mainly, **75**, ii, 267.

**1878–79.** Strengthening the breakwater by riprap; 1,675 t. of granite used, **79**, 52, 296.

**1879–80.** 1,211 t. of stone deposited at outside base of breakwater, **80**, 366.

**1881–82.** 2,550 t. stone placed in breakwater, **82**, 548.

**1886–87.** 2,441 c. y. dredged, **87**, 532.

**1887–88.** 21,389 c. y. dredged, **88**, 484.

**1889–90.** Dredging in 15½-f. area, **90**, 552.

**1890–91.** 22,100 c. y. dredged, **91**, 694.

**1891–92.** 6,360 c. y. dredged, **92**, 598.

**1893–94.** 21,880 c. y. dredged, **94**, 572.

**1896–97.** About 15,000 c. y. dredged, **97**, 884.

**1897–98.** 25,803 c. y. dredged, **98**, 896.

**Physical characteristics.**

Description, **70**, 459; **74**, ii, 182; **99**, 744.

**Projects.** (See *Estimates.*)

The original project was for a breakwater of riprap stone 1,170 f. in length, covering an anchorage area of about 175 acres and having an entrance depth of 15 f. This was commenced in 1827 and completed in 1838; cost, $70,931. **80**, 366; **86**, 586, 619.

By Maj. Warren, 1873, increasing width of base of breakwater and otherwise strengthening it; estimate, $25,000, **73**, 86, 948, 949.

By Lt. Col. Elliot, 1885, increasing the depth of the anchorage area within the harbor; estimate, $45,743.20, **85**, 621; **86**, 586; **87**, 532; **92**, 598.

Maj. Lockwood estimated, 1899, that it would cost $32,500 to complete the project of 1885, **1900**, 1286.

**Surveys.**

Examination by Lt. Col. Blunt, 1852, **73**, 948.

Examination by Maj. Houston, 1869, **70**, 459.

Under direction of Maj. Warren, by P. M. Blake, 1873, **73**, 948. Reports, **74**, ii, 180, 182.

Of harbor, 1884, **85**, 560, 619.

Examination ordered by act of Aug. 17,

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[a] Summary of, prior to 1870, **70**, 459; **73**, 947; **75**, ii, 267; **79**, 295.

## HYANNIS HARBOR OF REFUGE, MASS.—Continued.

1894, made by Capt. Bixby, 1895 (report favorable), **95**, 744.

Examination and survey ordered by act of Mar. 3, 1899, made by Maj. Lockwood, 1899 (limited improvement recommended), **1900**, 1284, 1286.

MAPS:

**84**, 592; **85**, 560; **93**, 804; **95**, 656.

Sketch showing proposed work, by Maj. Houston, **70**, 460.

## ILLINOIS AND DES PLAINES RIVERS, ILL.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 291; **99**, 485; **1900**, 549.

BOARD OF ENGINEERS:

Convened at Chicago, Ill., Apr. 10 and 11, 1899, under S. O. No. 14, dated Mar. 12, 1899 (for object, see *Surveys*), and reconvened Nov. 22, under S. O. No. 59, dated Nov. 11, 1899, and subsequently under S. O. No. 12, dated Mar. 12, 1900. (Col. J. W. Barlow, Majs. J. H. Willard and C. McD. Townsend.)

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1882–84. Reports, **84**, 1957, 1958.

Maj. W. L. Marshall, 1899. Report, **99**, 2890.

Maj. J. H. Willard, 1899. Report, **99**, 3855.

ASSISTANTS:

G. Y. Wisner. Report, **84**, 1960.

F. M. Towar. Report, **99**, 2891.

J. A. Seddon. Reports, **1900**, 3856, 3862.

**Operations.**

**1898–99.** Preparations made for putting survey party at work, **99**, 2890.

**Physical characteristics.**

Route described, **84**, 1958, 1960.

Description of route recommended for survey, **99**, 2891; routes surveyed, **1900**, 3858.

**Plans.**

By Maj. Benyaurd, 1884, slack-water navigation accomplished by locks and dams, estimate, $1,975,446 to $3,433,562, **84**, 1959, 1964.

**Projects.**

Board of Engineers estimated, 1900, that the provisional cost of an 8-f. channel would be $10,400,000, and that 10 per cent less than this would be the cost of a 7-f. channel, **1900**, 3861.

**Surveys.**

Ordered between La Salle and Joliet by act of Aug. 2, 1882, made under the direction of Maj. Benyaurd, **84**, 1958.

Survey for extension of navigation from Illinois River to Lake Michigan at or near Chicago, with estimates for 7-f. and 8-f. channels, ordered by act of Mar. 3, 1899, **99**, 2891. Made 1899–1900 under direction of Board. (Special report made on the Illinois Canal in connection with this survey.) Preliminary report, **1900**, 3856.

## ILLINOIS AND MICHIGAN CANAL. (Acquisition and enlargement of.)[a] (See *Illinois and Mississippi Canal.*)

**Commerce.**

Relation of the canal to commerce, **87**, 2130–2137, 2145.

Statement of canal traffic, **87**, 2148.

Rates of toll, **87**, 2156.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **83**, 289; **84**, 291; **85**, 314; **86**, 309; **87**, 275, 2127.

BOARD OF ENGINEERS. Of 1886 to examine and report upon the Illinois and Michigan Canal and its acquisition. Report, **87**, 2128–2160. (Lt. Cols. Comstock and Poe and Maj. Post.)

ENGINEERS IN CHARGE. Maj. W. H. H. Benyaurd, 1883–85. Reports, **83**, 1761; **84**, 1950; **85**, 2056.

Maj. T. H. Handbury, 1886. Report, **86**, 1716.

**Legislation.**

Acts relative to Illinois and Michigan Canal, **87**, 2161.

**Plans.**

By Maj. Benyaurd, 1882, enlarging the canal between Chicago and La Salle to a width of 80 f. at water line, and depth of 7 f.; locks 170 f. long and 30 f. wide; estimate, $2,298,919, **83**, 1762, 1774, 1779, 1788; **86**, 1713.

History and discription of canal, **87**, 2128, 2141.

Original cost of canal, $9,513,021, **87**, 2147, 2167.

Conclusions of Board of Engineers of 1886 in relation to acquisition and enlargement of canal, **87**, 2160.

**Survey.**

Ordered by act of Aug. 2, 1882, **83**, 290; made under direction of Maj. Benyaurd, 1883, **83**, 1754.

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[a] Illinois and Lake Michigan Canal via Illinois River, Ill. Surveys—Reports, June 23, 1834; estimate (Des Plaines and Illinois rivers), $4,299,439.81. (H. Doc. No. 482, 55th Cong., 2d sess.)

## ILLINOIS AND MISSISSIPPI CANAL, ILL. (See *Hennepin Canal.*)

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $500,000, | **91**, 2633. |
| 1892, | 500,000, | **92**, 2300. |
| 1894, | 190,000, | **95**, 2730. |
| 1896, | 45,000, | **96**, 2614. |
| 1897, | 875,000, | **97**, 2828. |
| 1898, | 1,427,740, | **98**, 2455. |
| 1899, | 700,000, | **99**, 2859. |
| 1900, | 1,000,000, | **1900**, 3816. |
| Total, | 5,237,740 | |

**Contracts.**

**1892.** Informal contract for fencing, **93**, 2840. A. J. Whitney, lock pit and foundation Lock 37 (work uncompleted), J. Killeen, lock pit and foundation, Lock 36, $14,679.60. J. D. Lynch, 3 miles of canal trunk earthwork, sand and pebbles, $40,266.02. D. Sears, lock pit and foundation and guard lock, $1,673.28. **93**, 2838.

**1894.** King Bridge Co., superstructure for 2 metal swing bridges, $11,200, **94**, 2171. W. Callahan, earthwork of miles 1, 2, 5, and 8, $29,879.04. E. Phelan, earthwork of miles 3 and 4, $23,041.66. J. Carroll, earthwork of mile 6, $6,002.88. Kenefick & Strang, earthwork of mile 7, $7,837.42. Mall & Doan, pits and foundations of Locks 1, 2, 3, and 4 (piles, earthwork, timber, ironwork, concrete), $41,547.03. Heidenreich Co., pits and foundations of Locks 6 and 7 (earthwork, piles, timber, ironwork, concrete), $18,872.12. Coil & McIvor, pit and foundation of Lock 5 (earthwork, piles, timber, ironwork, concrete), $8,010.90. **95**, 2734.

**1895.** Circular letter proposals for cement, **96**, 2618.

**1897.** Katz, Crandall & Callahan, earthwork of miles 9–16, $119,475. Cogan & Pound, 11 lock pits and foundations and 2 aqueducts (excavation, piles, timber, ironwork, concrete), $96,735.85. McArthur Bros., concrete and iron culverts, $24,815. **97**, 2832. J. J. McCaughey, earthwork of miles 17 and 18, $17,105.90. Globe Construction Co., earthwork of miles 9–23, $132,002.80. R. C. Cushing Co., earthwork of mile 24, $8,277. H. A. Boedker & Co., lock pits, and foundations, Locks 19, 20, 21 (excavation, piles, timber, ironwork, concrete), $26,239. **98**, 2459.

**1898.** Toledo Bridge Co., superstructure of 5 steel bridges, $8,200, **98**, 2459. J. E. Loomis, earthwork of miles 3 and 4 of feeder line, $24,895.25. Corbett & Currie, earthwork of mile 5 of feeder line, $9,502.71. Callahan Construction Co., earthwork of miles 1, 2, and 8 of feeder line, $67,503.19. Cogan & Pound, earthwork of miles 6 and 7 of feeder line, $42,155.52. J. Berkery, earthwork of miles 9, 10, and 11 of feeder line, 2,177,744 c. y., 8.4 cents; 132,182 c. y., 16½ cents. Kinser & Sons, earthwork of miles 12–16, feeder line, 98,696 c. y., 11 cents, and 297,515 c. y., 10 cents. **99**, 2865.

**1899.** J. G. Wagner, bridge across Rock River, $25,000. Kinser & Sons, earthwork of miles 19 and 20, feeder line, 241,823 c. y., 11.85 cents. Callahan Construction Co., earthwork, miles 21 to 29, feeder line, 288,502 c. y., 15½ cents; 372,263 c. y., 17¼ cents; 393,189 c. y., 16 cents; 102,592 c. y., 9¾ cents; 127,604 c. y., 12½ cents, and 167,621 c. y., 13¾ cents; pits for 7 arch and constructing 10 pipe culverts, for feeder line (earthwork, concrete, iron pipe, ironwork, timber, piles); $60,096.32. Lydon & Drews, removing wreck, $375. **99**, 2865. G. W. Jackson Construction Co., miles 17 and 18 of feeder line earthwork, 245,712 c. y., 9¾ cents, **99**, 2865. Carnegie Steel Co., 3 bridges, $40,473.27. Lassig Bridge and Iron Works, superstructure of 2 railway bridges, $29,195. Katz & Callahan, earthwork of miles 28, 29, 42 of western section, and 26, 27, and 28 of eastern section, $60,729.45. T. W. Kinser & Sons, earthwork of mile 40, western section, $14,093.99. J. J. McCaughey, earthwork of miles 45 and 48, western section, $24,526.35. Toledo Bridge Co., 5 steel highway bridges, $13,400. B. William, earthwork of miles 9, 10, and 11 of feeder line, $40,546.24. **1900**, 3824.

**1900.** Chicago Bridge and Iron Works, superstructure of railway bridge, $17,910, **1900**, 3824.

**Engineers.**

Chief of Engineers. Reports, **89**, 293; **90**, 263; **91**, 334; **92**, 320; **93**, 364; **94**, 336; **95**, 374; **96**, 329; **97**, 418; **98**, 406; **99**, 482; **1900**, 546, 550.

Board of Engineers. Convened at Rock Island, Sept. 12, 1891, by S. O., No. 48, to consider and report upon the location of the western terminus of the Illinois and Mississippi Canal. Report, **92**, 2302. (Col. Poe, Maj. Mackenzie, and Capt. Marshall.)

Engineers in Charge:

Capt. W. L. Marshall, 1889–99. Reports, **89**, 2148; **90**, 2580, 2581, 2604; **91**, 2633, 2640, 2646, 2650; **92**, 2297; **93**, 2832; **94**, 2162; (Maj.), **95**, 2726; **96**, 2608; **97**, 2825; **98**, 2447; **99**, 2853.

Maj. J. H. Willard, 1899–. Report, **1900**, 3810.

Assistants:

G. A. M. Liljencrantz. Reports, **89**, 2149; **90**, 2601.

L. L. Wheeler. Reports, **91**, 2643, 2653, 2655; **92**, 2301; **93**, 2838; **94**, 2172; **95**, 2758; **96**, 2652, 2656; **97**, 2859, 2861, 2870; **98**, 2482; **99**, 2886; **1900**, 3850.

Lt. H. Jervey. Reports, **95**, 2742, **96**, 2618; **97**, 2847.

## ILLINOIS AND MISSISSIPPI CANAL, ILL.—Continued.

J. C. Long. Reports, **93**, 2844; **94**, 2178; **95**, 2763; **96**, 2638; **97**, 2862; **98**, 2466; **99**, 2871; **1900**, 3829.

**Legal proceedings.**

For right of way, etc., **93**, 2835; **94**, 2180; **95**, 2728; **97**, 2827; **98**, 2454. All right of way obtained, **99**, 2855.

Rock River declared a navigable river by decree of U. S. Circuit Court, up to and beyond Sterling, prior to appropriation of $25,000 for the construction of a bridge to replace the bridge across the river at Moline, **98**, 2448.

**Obstructions.**

Bridges obstructing navigation, **96**, 2609.

**Operations.**

**1888–91.** Preparations of drawings, plans, and estimates for the proposed canal, **89**, 2148; **90**, 2580; **91**, 2633; **92**, 2301.

**1892–93.** *Western section:* 2 lock pits and foundations completed; about 300,000 c. y. earthwork excavated from canal trunk and placed in embankment; dams, locks, and culvert in course of construction; earth and stone excavations and embankment construction in progress; warehouses built, etc., **93**, 2833.

**1893–94.** *Western section:* 3 locks, 7 sluices, 1 culvert, and abutments for pontoon bridge completed; the earthwork and rock excavation of the canal around the lower rapids of Rock River nearly completed, and preparations made for construction of dams, bridges, gates, etc., **94**, 2163, 2164.

**1894–95.** *Western section:* Several bridges constructed, excavation and embankments along the section completed, cofferdams and cross banks removed, approaches to locks dredged, banks riprapped, lock houses constructed, gates hung, and dams completed; nearly completing canal around the lower rapids of Rock River, which was opened to navigation on Apr. 17, 1895. **95**, 2727.

*Eastern section:* 4 miles canal trunk and 4 lock foundations completed, and similar work in progress; culverts constructed and others in course of construction; several locks commenced, 5 miles of construction railway laid, warehouses and one bridge built, **95**, 2729.

Cement tests made, **95**, 2742.

**1895–96.** *Western section:* Dredging plant built, the entrance at the Mississippi dredged, pile revetments constructed, filling placed, riprapping done, and similar work performed, **96**, 2610, 2611.

*Eastern section:* 6 locks completed, the masonry of an aqueduct and 2 culverts also completed, as well as foundations for 3 locks. All masonry on first 8 miles has been completed at the end of this year, and also nearly all the earthwork. **96**, 2612.

Cement tests made, **96**, 2618.

**1896–97.** *Western section:* Mississippi entrance dredged, and also approaches to landing at Blossomburg, wing dams constructed at mouth of Rock River, **97**, 2827.

*Eastern section:* Earthwork of sixth mile completed and preparations made for continuing work next year, **97**, 2826.

Cement tests made, **97**, 2847.

**1897–98.** *Western section:* Preparations made for continuing work next year, **98**, 2454.

*Eastern section:* 8 miles canal trunk completed, 2 practically completed, and work on 8 miles more begun; foundations of 9 locks completed, and work begun on 5 more and also one aqueduct; 3 bridges erected, and 8 culverts built. About 8 miles of canal trunk lined with stone, filling behind 7 locks and splay walls completed; masonry of 3 locks and abutments of 5 highway bridges constructed, and approaches to bridges nearly completed; several buildings (lock houses, etc.), erected, and 5 miles of construction track laid. **98**, 2449, 2450.

Cement tests made, **98**, 2451, 2480.

**1898–99.** *Eastern section:* 9 miles lined with stone, superstructure of 2 bridges placed, approaches to 5 bridges completed, masonry of 11 locks, and the abutments of 2 aqueduct bridges and 1 highway bridge completed and of 1 highway bridge begun; culvert placed under canal; 164,937 c. y. earth filling placed behind lock walls and aqueduct abutments and approaches to bridges, all by hired labor. By contract 4 miles completed and 2 more partly completed; pits and foundations of 5 locks and of 2 aqueduct bridges completed. *Feeder line:* Work in progress on 15 miles of trunk, 778,735 c. y. being placed. **99**, 2853.

**1899–1900.** *Eastern section:* About 2 miles of earthwork completed; about 7 miles of trunk lined; abutments and approaches to 5 highway bridges completed, and 3 other such works under way; abutments and approaches to 2 railroad bridges completed and for 1 other in progress; about 6 culverts completed, and superstructure of 2 aqueduct bridges erected, all by hired labor. By contract nearly 4 miles completed; superstructure of 5 highway, 1 single-track and 1 double-track railway bridge completed. *Feeder line:* Concrete masonry work on culverts and for about 5 bridges carried on by hired labor. By contract, 2,480,867 c. y. earthwork executed; foundations for 4

## ILLINOIS AND MISSISSIPPI CANAL, ILL.—Continued.

culverts completed; 4 pipe culverts completed and pits for 5 more partly excavated.

*Western section:* Warehouse built and 4 others in progress; 2 culvert pits excavated, fencing done, and right of way staked out, and earthwork completed by hired labor. By contract, about 414,773 c. y. earthwork was executed. **1900**, 3810.

**Physical characteristics.**

Description of approved canal route, **90**, 2582.

Elevations of high water in 1892 along Rock River from Pennys Slough to the Mississippi, **93**, 2843.

Stages of the Mississippi at Rock Island for 1893, **93**, 2843.

Rock River was gauged in 1895–96 and its discharge found to be 723 c. f. per second, less than previously estimated, **96**, 2610.

Description of Sterling route of canal, **96**, 2653.

Description of Green River route, **97**, 2868.

Part of feeder line situated in Cecils Slough found to overlie a deep peat bog, making necessary surveys for different line, **1900**, 3811.

**Plans.** (See *Projects.*)

Location of proposed canal and feeder routes, **90**, 2588, 2589, 2609.

Dimensions of proposed canal and constructions proposed, **90**, 2589.

Details of lock, bridge, sluiceway, and dam construction, **90**, 2590.

Itemized estimates of cost, **90**, 2596.

General considerations relating to the work, **90**, 2599; **91**, 2639. Total estimate, $6,925,960, **90**, 2597; **92**, 2300.

Western terminous of canal located by Board of Engineers, 1891, upon the south side of the principal mouth of Rock River, **92**, 2310.

**Projects.** (See *Plans.*)

Comparative estimate of alternate lines from mile 6.5 to mile 12.4, inclusive, **93**, 2845.

Tabular statement of comparative estimates for construction of canal from mile 25 westward to the mouth of Green River by two routes, **94**, 2181.

Capt. Marshall, 1893–94, estimated the cost of the canal around the lower rapids of Rock River, exclusive of surveys and expenses of right of way, at $472,000, **94**, 2166.

By Maj. Marshall, 1896–97, for locating the feeder 4 miles west, leaving Rock River at Sterling instead of Dixon, at an estimated cost of $1,654,733.30, **96**, 2655; **97**, 2868.

By Maj. Marshall, 1896, for location of western section of canal via Green River route; estimated cost, $2,048,444.97, **97**, 2867, 2869.

Comparative estimates of cost of alternate lines for canal, surveys of 1895 and 1897, respectively, in the vicinity of Colona, Ill., **97**, 2861.

By Capt. Marshall, 1888, and modified in subsequent years, for the construction of a canal about 75 miles long and at least 80 f. wide at the water surface, 7 f. deep, with locks 170 f. long between quoins and 30 f. wide admitting barges carrying 600 short tons of freight, from 1¾ miles above Hennepin, Ill., thence via Bureau Creek Valley and over the summit to Rock River at the mouth of Green River, thence by slack water in Rock River to a canal around the lower rapids of the river at Milan, to the Mississippi at the mouth of Rock River; ascending through 21 locks and descending by 10 lift locks, with 1 guard lock, with a feeder line 29 miles long; estimated cost 1890, $6,925,959.70, **97**, 2870; estimated cost 1896, $7,157,379.74, **97**, 2870; **98**, 2447.

Plans for flushing culverts carried under the canal (drawings), **99**, 2858.

Intermediate masonry piers substituted for pedestals and columns on the feeder line, **99**, 2858.

Line F of the various routes surveyed in place of the line through the boggy Cecils Slough chosen, **1900**, 3811.

Lock site near Colona changed to prevent extensive changes in the grade of two railroads intersecting near that point, **1900**, 3811.

Aqueduct over Green River on the feeder line to be used in drawing down both the feeder line and the summit level in case of accident or when repairs are to be made, **1900**, 3812.

**Surveys.**

Miscellaneous surveys for location of main line, feeder, etc. (see *Physical characteristics*, 1900), **93**, 2835; **94**, 2166; **95**, 2728; **96**, 2650, 2652; **97**, 2827, 2861, 2866; **98**, 2479.

Survey for feeder line along Sterling route made under direction of Maj. Marshall in 1895–96, **96**, 2611, 2653.

Survey of Green River route made in 1896 under direction of Maj. Marshall, **97**, 2867.

Examination of Rock River feeder for lock and dam in progress, 1900, **1900**, 550.

MAPS. **91**, 2649; **94**, 2176; **96**, 2670; **97**, 2878; **98**, 2482, 2484.

## ILLINOIS AND MISSISSIPPI CANAL (Operation and care of).

**Appropriations.**[a]

| | |
|---|---|
| 1895, | $255.00 |
| 1896, | 5,309.17 |
| 1897, | 4,752.46 |
| 1898, | 4,502.39 |
| 1899, | 3,364.92 |
| 1900, | 5,379.84 |
| Total, | 23,563.78 |

**Commerce.**

Description of, **96**, 2672; **97**, 2880.

After opening of the canal freight rates on coal were reduced, **96**, 2672. The canal a cause for reduced rates on coal freights, **97**, 2880.

In 1896-97 56,621 t. passed through the canal around the Rock River Rapids, necessitating 1,531 lockages, **97**, 2880.

**Engineers.**

Chief of Engineers. Reports, **95**, 375; **96**, 331; **97**, 420; **98**, 408; **99**, 484; **1900**, 549.

Engineers in Charge:

Maj. W. L. Marshall, 1895-99. Reports, **95**, 2770; **96**, 2672; **97**, 2880; **98**, 2486; **99**, 2888.

Maj. J. H. Willard, 1899-. Report, **1900**, 3853.

Assistant. L. L. Wheeler. Reports, **97**, 2881; **98**, 2487; **99**, 2890; **1900**, 3854.

**Legal proceedings.**

The authority of the U. S. to order the alteration of an obstructing bridge below Moline sustained by the U. S. circuit court, **97**, 2880.

**Obstructions.**

Navigation obstructed by three bridges above the head of the canal around the rapids of Rock River, **95**, 2771.

**Operations.**

**1894-95.** Canal around the lower rapids of Rock River opened to navigation on Apr. 17, 1895. Operation and maintenance in progress from this date on, **95**, 2770.

(For account of operations, etc., in detail see each annual report.)

## ILLINOIS RIVER, ILL.[b] (See *Illinois and Michigan Canal, etc.*; *Mississippi River.*)

**Appropriations.**[c]

| | | |
|---|---|---|
| 1852, | $30,000, | **66**, iii, 35; **79**, 1569. |
| 1867, | [d] 20,000, | **67**, 270. |
| 1868, | 84,150, | **67**, 54; **70**, 60; **79**, 1575. |
| 1870, | 100,000, | **70**, 60. |
| 1873, | 100,000, | **73**, 53. |
| 1874, | 75,000, | **74**, 60. |
| 1875, | 75,000, | **75**, 65. |
| 1876, | 40,000, | **76**, 84. |
| 1878, | 75,000, | **78**, 119, 1192. |
| 1879, | 40,000, | **79**, 159, 1571. |
| 1880, | 110,000, | **80**, 1994. |
| 1881, | 250,000, | **81**, 2181. |
| 1882, | 175,000, | **82**, 2246. |
| 1884, | 100,000, | **84**, 1948. |
| 1886, | 112,500, | **86**, 1706. |
| 1888, | 200,000, | **88**, 1891. |
| 1890, | 200,000, | **90**, 2410. |
| 1892, | 100,000, | **92**, 2259. |
| 1894, | 35,000, | **95**, 2717. |
| 1896, | 40,000, | **96**, 2599. |
| 1899, | 100,000, | **99**, 2844. |
| Total, | 2,041,650 | |

**Commerce.** (See *Defense.*)

Work demanded by interests of, **68**, 371.

Value of improvement to, **68**, 452; **71**, 278.

Importance of the improvement, **87**, 2122.

Commercial advantages of a waterway between the Great Lakes and the Mississippi River, **90**, 2454.

List of merchant steamboats navigating the Mississippi and its tributaries, with drafts from 7 to 9 feet and less, **90**, 2538, 2540.

Lockages and tonnage passing Lagrange Lock for 1892, **92**, 2296, 2297.

Since the completion of the locks, a steady increase in the number of passages of boats and in tonnage, **95**, 2716; **97**, 2816; **98**, 2437.

Total traffic estimated at about 500,000 t. per annum, **95**, 2717; **96**, 2599.

The tonnage on the river in 1896 such that less than one-tenth cent per mile paid for the maintenance of the works, though the practicable depth only 4 f., **96**, 2598, 2599.

Since the construction of the Lagrange Lock, 1889, traffic on the river increased 200 per cent, up to 1899, **99**, 481.

**Contracts.**[e]

**1869.** F. D. Van Wagenen, dredging between the town of Henry and Copperas

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[a] Expenditures under the permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

[b] Survey—Report, Feb. 14, 1868; estimate, $12,745, and $4,245 annually for maintenance. (H. Doc. No. 482, 55th Cong., 2d sess.

[c] Statement of reversions to United States Treasury, **72**, 312; statement of total applied to jetties and dredging, **76**, 679. **79**, 1576, 1584.

[d] Allotted from Western and Northwestern rivers.

[e] Operations under contract from 1869 to 1878, **79**, 1581. Objections to laws regulating, **68**, 391.

Proposals: For dredging, hire of dredge and equipment, construction of brush dams, jetties, riprap, and training walls, **70**, 221. **71**, 281; **75**, 474; **77**, 553. For lock foundation at Copperas Creek, **74**, 322.

## ILLINOIS RIVER, ILL.—Continued.

Creek, **70**, 322; completed July, 1871, **72**, 311.

**1870.** J. T. Hayden (expenditure of appropriation of 1870, $100,000), dredging and construction of dams between Copperas Creek and mouth of river, **71**, 277, 282; **72**, 311; completed July, 1872, **72**, 311.

**1873.** W. Johnson, foundation for the lock near Copperas Creek, delay and tardiness of, **74**, 317, 318, 322. Allotment exhausted and contract completed (Sept., 1874), **75**, 467, 469, 475.

**1874.** W. Johnson (expenditure of allotment, $20,000, from appropriation of 1873), hire of dredge and equipment, $12 per hour, to restore channels of 1871–72, **74**, 319; completion of, Aug., 1874, **75**, 469. G. Williams (expenditure of appropriation of 1874, $75,000), dredging, construction of dams, jetties, and repairs, **75**, 470, 475; contract extended; completed Oct., 1875, **75**, 470, 475; **76**, 676, 683.

**1875.** W. Patrick (expenditure of appropriation of 1875, $75,000), dredging, construction of dams and jetties, **75**, 471, 475; **76**, 676; contract extended to Oct., 1876, **76**, 683; completed, **77**, 546, 549; renewed with, Oct., 1876 (for expenditure of allotment of $10,000 from appropriation of 1876, $40,000), on same terms as preceding contract; completed Oct., 1876, **77**, 546, 549, 553.

**1877.** H. S. Brown (expenditure of balance of appropriation of 1876), dredging, construction of dams and jetties, **77**, 546, 549, 553; extended to June, 1878, **78**, 1197.

**1884.** Sanger & Moody, stone, **84**, 1950.

**1886.** Sanger & Moody, lock stone, **87**, 2124.

**1887.** Williams, White & Co., lock-gate iron, **87**, 2124.

**1891.** Sanger & Moody, furnishing and delivering stone, **92**, 2261.

**1892.** Russell Wheel and Foundry Co., iron and steel lock-gate fittings, $9,850.65; H. B. Wyeth, yellow-pine timber, $19 per M f. B. M.; A. R. Beck Lumber Co., pine lumber, $18.70, and pine plank, $16.95 per M f. B. M., **92**, 2260.

**Defense.**

Improvement required to pass gunboats from Mississippi River to lakes, **68**, 442. Naval and military considerations favoring improvement, **68**, 450; **70**, 304; **79**, 1573.

**Documents.** (Not printed in reports.)

H. Doc. 16, 40th Cong., 1st sess., **67**, 37, 269; **79**, 1573.

**Engineers.**

Chief of Engineers. Reports, **67**, 37; **68**, 54; **69**, 46; **70**, 60; **71**, 54; **72**, 50; **73**, 53; **74**, 60; **75**, 64; **76**, 83; **77**, 85; **78**, 119; **79**, 158, 1584; **80**, 211, 212; **81**, 286; **82**, 281; **83**, 289; **84**, 290; **85**, 313; **86**, 308; **87**, 274; **88**, 249; **89**, 289; **90**, 261; **91**, 332; **92**, 318, 319, 335; **93**, 362; **94**, 334; **95**, 372; **96**, 327; **97**, 415, 421; **98**, 404, **99**, 480; **1900**, 545.

Board of Engineers. Organization of; survey and examination under direction of, 1867, **67**, 270. Plan of improvement; recommended the widening and deepening of present canal from Bridgeport to Lake Joliet; thence by river (except at Grand Rapids) to mouth, **68**, 440; **79**, 1574, 1576. (Lt. Col. Wilson and W. Gooding, U. S. C. E.)

Engineers in Charge.

Lt. Col. J. H. Wilson, 1866–70; **67**, 273. Reports, **66**, ii, 41; **67**, 269; **68**, 389, 438; **69**, 217; **70**, 303; **71**, 264.

Col. J. N. Macomb, 1870–77. Reports, **71**, 258; **72**, 281; **73**, 437; **74**, 317; **75**, 467; **76**, 674; **77**, 546.

Capt. G. J. Lydecker, 1877–82; **78**, 1190. Reports, **78**, 1190; **79**, 1569, 1572; (Maj.), **80**, 1990, 1995; **81**, 2174.

Maj. W. H. H. Benyaurd, 1882–86. Reports, **82**, 2245; **83**, 1751; **84**, 1948; **85**, 2052; **86**, 1705.

Maj. T. H. Handbury, 1886–87. Report, **87**, 2119.

Capt. W. S. Marshall, 1888–99. Reports, **88**, 1889; **89**, 2120; **90**, 2407, 2419, 2454, 2574; **91**, 2611, 2630; **92**, 2255, 2294, 2658, 2660; **93**, 2822; **94**, 2150; (Maj.), **95**, 2714; **96**, 2597; **97**, 2815, 2882; **98**, 2436; **99**, 2841.

Maj. J. H. Willard, 1899. Report, **1900**, 3798.

Assistants.

Capt. P. C. Hains, **66**, ii, 41.

J. Worral, **67**, 270. Report, **68**, 459.

G. B. Griffin, **67**, 270; **68**, 389.

G. A. Keefer, **67**, 270; **68**, 389; **69**, 217.

L. L. Nichols, **67**, 270; **68**, 389.

R. E. McNath, **67**, 271; **68**, 389. Reports, **69**, 219; **70**, 313; **71**, 271; **72**, 311.

I. D. McKown, **70**, 320.

R. A. Brown, **72**, 315. Reports, **74**, 318; **75**, 468; **76**, 675.

H. A. Ulffers, **68**, 389; **69**, 217, 219; **71**, 265; **77**, 548.

W. Hormuth, **69**, 219.

S. T. Abert, **68**, 449; **79**, 1572.

G. B. Hegardt. Report, **88**, 1892.

W. M. Childs. Reports, **89**, 2126; **90**, 2410; **91**, 2626, 2631.

L. L. Wheeler. Reports, **89**, 2127; **90**, 2456.

C. V. Brainard. Reports, **92**, 2261,

**ILLINOIS RIVER, ILL.**—Continued.

2295; **93**, 2825; **94**, 2153; **95**, 2721; **96**, 2600; **97**, 2817; **98**, 2438; **99**, 2845; **1900**, 3800.

**Estimates.** (See *Plans* and *Projects.*)

By S. T. Abert, improvement from La Salle to mouth, by dredging and wing dams, to give an available depth of 4 f., $1,528,450, **68**, 449; **79**, 1573. For a depth of 6 f., by drawing a supply from Lake Michigan, more than $38,000,000, **68**, 450,453.

By Board of Engineers, widening and deepening present canal to Lake Joliet, and from thence the improvement of river by locks and dams, $18,217,242, **68**, 390, 453, 467; **79**, 1574, 1577. Details of, **68**, 456.

Of cost of completion of modified project of 1870, formation of channel (150 f. by 4 f.) by dredging and wing dams, $391,912, less appropriation of 1870, $100,000, $291,912, **71**, 279.

Of cost of completion, $350,000; cause for increase, **72**, 281, 314. Of cost of lock foundation at Copperas Creek, $72,479, **74**, 319.

Of cost of completion (dredging and wing dams), $120,000.

By Capt. G. J. Lydecker, 1879, channel 200 f. wide and 4½ f. deep by dredging and wing dams, $250,000, **79**, 158, 1571.

**Legislation.**

Act of Congress, June 23, 1866, under which W. Gooding was appointed to cooperate with officer in charge, **67**, 37, 270. Action recommended providing for early commencement of work, **67**, 271. Possible effect of adoption of new constitution by State, **70**, 304. Construction of lock and dam at Henry ordered by general assembly of Illinois, **69**, 46, 218. Recommendation that Illinois River be included with Mississippi River in act providing for sheer booms and piers, **77**, 561.

Chicago drainage and waterways laws, **89**, 2134; **90**, 2449, 2550.

**Operations.** [a]

**1859.** Former dredging on river, effect of, **69**, 218. Order in which improvements should be made (under project of Board of Engineers, 1867), **68**, 452.

**1869-70.** Dredging on bars to give a depth of 7 f. between Henry and Copperas Creek after the proposed dam at Henry shall have been built, **70**, 60, 303, 313.

**1870-71.** Dredging; construction of jetties to obtain a present depth of at least 4 f.; channel way prepared between Henry and Copperas Creek for a depth of 7 f. when dam shall have been constructed, **71**, 54, 274.

**1871-72.** Continuation of operations of previous year, **72**, 50, 281, 311. The State of Illinois undertakes the building of locks and dams and the United States to prepare river bed, so as to afford (when dams are built) a depth of 7 f., **73**, 437.

**1873-74.** Construction of foundations for lock at Copperas Creek and continuation of dredging at points where most required, **74**, 60, 317.

**1874-75.** Lock foundations turned over to State of Illinois for completion of lock; construction of low-water channel by dredging and wing dams, **75**, 65, 467, 471.

**1875-76.** Continuation of dredging and wing dams, **76**, 83, 675, 677, 687.

**1876-77.** Continuation of dredging, building low dams and jetties, and restoration of channels, **77**, 85, 546, 551, 554.

**1877-78.** Dredging by contract on worst bars to give a channel 4 f. deep, **78**, 119, 1190, 1193, 1196. Cost of work by contract and hired labor discussed, **78**, 1191, 1192, 1195; **79**, 1569. Plan of dams and jetties built, **78**, 1194. Permanence of improvements made, **78**, 1194.

**1878-79.** Operations limited to construction of dredge, 2 dump scows, 2 deck scows, quarter boat, tow boat, and steam scow, in preparation for doing the work by hired labor, **79**, 159, 1569, 1580.

**1879-80.** 110,237 c. y. dredged at Pearl Shoals, Fishers Island, Atwells, and Silver Creek bars; 5,858 l. f. brush and stone dams built at above localities; 84 snags removed, **80**, 1991, 1992.

**1880-81.** 89,501 c. y. dredged at Atwells and Hurricane Island bars; work on Kampsville lock commenced, **81**, 2174.

**1882-83.** Cofferdam and lock foundation constructed and lockpit excavation commenced at Lagrange; lockpit and cofferdam construction at Kampsville continued, **83**, 1751, 1752.

**1883-84.** Foundation of Lagrange lock completed and lock walls commenced; foundation of Kampsville lock completed, **84**, 1948, 1949.

**1884-85.** Work upon lock walls at Lagrange continued; east dam abutment completed, **85**, 2052.

[a] History of previous operations, **79**, 1569, 1572, 1581. Difficulties of using ordinary dump scows, and remedy for, **70**, 315. Cost of dredging in 1870-71 (24½ cents per c. y.), **71**, 272. Operations suspended (1872) for lack of funds, **72**, 281. Superiority of Osgood dredges over Morris & Cummings, **72**, 311. Order in which bars should be removed, **72**, 314. Dredging done by hired equipment, 1874, **74**, 319. Present relief aimed at, **74**, 320. Details of lock foundation at Copperas Creek, **75**, 469. Satisfactory character of, **75**, 467. Satisfactory results from low dams and training walls, **76**, 674, 677. Injury done by storms to improved channel, **77**, 548.

## ILLINOIS RIVER, ILL.—Continued.

**1885–86.** Lock walls at Lagrange completed, **86**, 1705.

**1886–87.** Progress upon work at Lagrange and Kampsville locks, **87**, 2120.

**1887–88.** Lock at Lagrange completed; 2,881 c. y. cut stone delivered; 26,061 c. y. dredged from the channel, **88**, 1890.

**1888–89.** Lagrange dam begun; 1,284 c. y. cut stone and 2,300 c. y. backing stone received from Kampsville lock, **89**, 2122.

**1889–90.** Lagrange lock and dam completed; work continued upon the Kampsville lock and dam, **90**, 2408.

**1890–91.** Repairs to Lagrange lock and dam; preparations for laying up Kampsville lock; repairs to plant, **91**, 2612.

**1891–92.** 212 l. f. of revetment and an ice breaker built at Lagrange lock and dam, and 12,500 c. y. dredged from lock approaches; 9,000 c. y. dredged at Kampsville lock site; 1,170 l. f. of trestle completed; 10,145 c. y. masonry laid in lock walls; 27,479 c. y. dredged above and below lock pit, **92**, 2257. Operation and care of Lagrange lock and dam, **92**, 2294.

**1892–93.** 500 c. y. riprap deposited below Lagrange lock and dam, and dredging to maintain approaches. The Kampsville lock and dam completed, involving, among other work, the dredging of 31,614 c. y. Repairs made to the Kampsville lock and dam, **93**, 2824.

**1893–94.** Kampsville dam fully completed; lock opened to navigation, **94**, 2151.

**1894–95.** 102,836 c. y. dredged, 270 snags removed, 2 lock houses constructed, and repairs made to plant, **95**, 2714. Two new dumping scows constructed, **95**, 2715.

**1895–96.** 82,000 c. y. dredged, **96**, 2597.

**1896–97.** Repairs and renewal of plant made, and 51,631 c. y. dredged, **97**, 2816.

**1897–98.** 112,048 c. y. dredged, and plant repaired, **98**, 2436.

**1898–99.** 17,183 c. y. dredged; revetment at Kampsville lock partly filled; plant repaired, **99**, 2842.

**1899–1900.** 307,043 c. y. dredged; 8,500 c. y. earth placed on grounds at Kampsville lock, and 3,710 c. y. earth placed on grounds at Lagrange lock; plant repaired and enlarged, **1900**, 3799.

**Physical characteristics.**

Of valley of Des Plaines, **68**, 442, 460.

Porous character of Illinois River bed and banks, **69**, 254.

Character of lock and dam foundations, **69**, 254.

Action of high water in river and tributaries, **72**, 313.

Stage of water during 1875–76, **76**, 684.

Illinois River formerly outlet of Lake Michigan, **68**, 442; **75**, 396.

Discharge of river, **68**, 444, 448; **79**, 1578.

Discharges of Illinois River and Illinois & Michigan Canal, **89**, 2132, 2133; **90**, 2409, 2443. On Illinois River at Ottawa, Ill., **90**, 2536. At Kampsville, 1891, **92**, 2263.

Gauge readings on the Illinois River at Kampsville from 1881 to 1889, **90**, 2414. Above Copperas Creek dam, Illinois, from 1879 to 1890, **90**, 2520. At Lagrange, from 1883 to 1890, **90**, 2532. At Copperas Creek and Lagrange and Kampsville locks, 1891, **92**, 2267, 2269.

Overflow stage of Illinois River, **90**, 2443.

Effects of definite increased discharge upon channel depths, **90**, 2444.

Average length of time that the dams upon the Illinois are necessary for navigation, **90**, 2446.

Influence of dams upon flood heights and upon flowage of lands, **90**, 2447.

Borings upon proposed routes between Chicago and Sag Bridge, **90**, 2461, 2482.

Elevations of high waters between Joliet and Lasalle, **90**, 2515.

Lake Michigan water levels from 1860 to 1890, **90**, 2517, 2518.

In 1897 the only navigable connection of the Illinois River and Lake Michigan was the Illinois and Michigan Canal, which extended from Chicago River, about 5 miles above its mouth, to Lasalle, **97**, 2883.

Gauge readings. (See end of each report from 1892, inclusive.)

Description of routes for extension of navigation from Illinois and Des Plaines rivers to Lake Michigan, **97**, 2883.

Amount of water to be pumped into the Illinois River by the city of Chicago, and description of its probable effect, **95**, 2715.

Channels dredged in the river found to be permanent, **95**, 2716.

The capacity of the canal about 20 per cent below that of the enlarged Erie Canal of New York, **96**, 2598.

The clearing and use of bottom lands in the vicinity of the river, and the leveeing of the lands, increasing, **97**, 2816, **98**, 2437.

The channel of the river fast becoming, 1899, one of the best tributaries of the Mississippi, **99**, 481.

Discharge probably to be augmented by Chicago Sanitary Canal, **99**, 2842.

Extremely low water, 1899, **1900**, 3798.

## ILLINOIS RIVER, ILL.—Continued.

**Plans.** (See *Estimates* and *Projects.*)

For connection of Illinois River with Lake Michigan, via Kankakee and Des Plaines rivers, not feasible, **68**, 441.

Entrance to Lake Michigan via Calumet River not feasible from lack of proper harborage at Calumet, **68**, 441, 460.

Route via Fox River considered impracticable from lack of water supply and cost of improvement, **68**, 441, 466.

Improvement from Lasalle to mouth by dredging and wing-dams would give an available navigation of not more than 4 f.; not considered to meet requirements, **68**, 449, 465.

Drawing a supply from Lake Michigan to give requisite depth in Illinois impracticable at any reasonable cost, **68**, 449, 465; **79**, 1573, 1574.

Obtaining a depth of 7 f. in Illinois River by a system of dams, with open chutes or passes, less in area than the navigable cut proposed to be made from Lake Michigan; plan largely experimental, **68**, 465.

By Capt. Marshall, 1890, excavation of a canal from Lake Michigan to Sag Bridge; width of canal to be 160 f.; estimated cost by the Chicago route, for a 14 f. depth, $10,689,591; for an 8 f. depth, $8,791,056; for a 14 f. depth by the Sag route, $8,501,041; for an 8 f. depth, $5,793,303, **90**, 2419, 2422, 2425, 2428, 2429, 2430, 2431.

Total estimate for the two projects from Lake Michigan through to Lasalle: For the 14 f. project via Chicago route, $48,282,763; via Sag route, $46,094,213; for the 8 f. project via Chicago route, $26,883,153; via Sag route, $23,885,400, **90**, 2433.

Comparative advantages of the two routes from Sag Bridge to Lake Michigan, **90**, 2435.

Detailed report upon surveys and estimates for the above proposed waterways, **90**, 2456.

**Private (Corporate and State) work.**

Michigan and Illinois Canal (see Projects), present location of, **68**, 442; dimensions of; condition of, **68**, 443; history and cost, **68**, 454; capacity of, **68**, 455. Construction, by State of Illinois, of lock and dam at Henry, **73**, 437; **79**, 1576. Conjoint action between State of Illinois and United States, **79**, 1576.

Probable removal of State works because of augmented discharge of the river due to Chicago Sanitary Canal, **99**, 2842.

**Projects.** (See *Estimates* and *Plans.*)

Previous to 1866 maintenance of low-water channel from La Salle to mouth by dredging, **69**, 218.

Board of Engineers, 1867, widening and deepening present (Michigan and Illinois) canal from Bridgeport (south branch Chicago River) to Lake Joliet, except between Summit and the Sag (11¼ miles), where independent canal will be built; thence by improvement of Illinois River by locks and dams, except passage of Grand Rapids by independent canal. Canal 160 f. wide, 6 f. deep; locks, 356 f. by 75 f, by 7 f.; depth of slack-water improvement, 6 f., **68**, 390, 440; **79**, 1574, 1576. Discussion of location, **68**, 443, 461; **69**, 252. Slack-water navigation compared with canal, **68**, 446. Estimate, $18,217,242, **68**, 390, 453, 467.

The State of Illinois having directed construction of lock and dam at Henry, **69**, 46, 218; and contemplating another at Copperas Creek, **69**, 46, 218; Lt. Col. Wilson, 1870, proposed, until locks and dams for slack-water navigation be completed, to confine expenditures to removal of worst bars and formation of channel (by dredging and wing-dams) from Henry to mouth 150 f. wide and 4 f. deep, **70**, 60, 304; **71**, 54, 275, 278; **72**, 281, 314; **79**, 1575, 1579. Objections, **79**, 1577.

Project for expenditure of available funds, 1873, putting in lock bottom and foundation at Copperas Creek, and such dredging as would best relieve the immediate wants of navigation, **73**, 437; **74**, 60, 317.

Projects for continuing improvement, 1874–77, by dredging; construction of wing-dams and training-walls to secure a depth of 4 f., **74**, 320; **75**, 65, 467; **76**, 83, 674; **77**, 85, 546.

Dredging by hired labor, 1878, with dredges especially adapted to the work, **78**, 1191; and constructing wing-dams by hired labor, **78**, 1192, 1195; **79**, 1570, 1580.

History of past projects reviewed by Capt. Lydecker, **79**, 1579. Disadvantages of existing dams and locks at Copperas Creek and Henry, **79**, 1579.

Previous to 1880 efforts on the part of the General Government for the improvement of the river consisted in the construction of wing-dams and dikes, dredging through the worst bars, and the construction of the foundation of the Copperas Creek Lock, the State of Illinois undertaking the building of locks and dams and the United States the improvement of the river-bed, **71**, 247; **73**, 437; **74**, 320; **75**, 467; **86**, 380.

The amount thus expended from 1868 to June 30, 1880, was $550,450, **80**, 1994, 1999; **86**, 308.

The act of June 14, 1880, required that $100,000 of the $110,000 appropriated should be applied to the construction of locks and dams, **80**, 276; **81**, 2174.

The project of 1880 proposed the ex-

## ILLINOIS RIVER, ILL.—Continued.

tension of slack-water navigation 100 miles by the construction of locks and dams at La Grange and Kampsville and the dredging of the river channel where needed between Copperas Creek Dam and mouth of river to obtain a low-water depth of 7 f., **81**, 2176, 2177. Estimated cost of the two locks and dams, $680,000; for dredging, brush dams, and shore protection, $270,850, **81**, 2177, 2181; **82**, 2246.

In 1883 the estimate for locks and dams was increased to $850,000, **83**, 1753.

From 1880 to 1886, inclusive, $747,500 was appropriated. In 1887 it was estimated that $587,500 would be required to complete the project, **87**, 2124. Increased in 1889 by $25,000, **89**, 2126.

In 1895 Maj. Marshall estimated it would cost $397,000 additional for dredging, **95**, 2716; and in 1897 that it would cost $75,000 to make necessary surveys and preparation of plans for the extension of navigation from Illinois River to Lake Michigan, **97**, 2887.

Probable necessity for lowering dam crests because of augmented discharge due to Chicago Sanitary Canal, and consequent reduction of lift of locks, **99**, 2842

**Surveys.**

In progress, **66**, iii, 35.

Below Lasalle completed in 1866; report transmitted and printed as H. Doc. 16, 40th Cong., 1st sess., **67**, 37.

$20,000 set apart for survey of Illinois River from appropriations for "Surveys of Western and Northwestern rivers," **67**, 270.

Between Lasalle and Chicago in porgress, 1867, **67**, 271. Completed Dec., 1867, **68**, 390, 439. Results of, **68**, 440. Careful nature of, **68**, 466. Previous surveys consulted, **68**, 439.

Surveys for sites of locks and dams, 1869, **69**, 253, 254. Gaugings, results of, **69**, 253. Borings; results of, and method of making, **69**, 254.

Resurvey of river bed, 1870, **70**, 303. Hoffman's sounding machine used, **70**, 318; **72**, 315. Efficiency and saving of, **70**, 319. Method of using, **70**, 320.

Obstructions surveyed, 1874; list of, **74**, 319.

Resurvey of bars, 1876, **76**, 678; 1877, **77**, 551.

History of early surveys, **79**, 1573.

Ordered by act of Mar. 3, 1879, made, 1880, under direction of Maj. Lydecker, **80**, 1995.

Survey for waterway between Lake Michigan and the Mississippi River ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Marshall, **89**, 2123, 2127, 2419.

Survey of Illinois River, from Lasalle to the Mississippi, with a view to ascertaining lands subject to overflow by the construction of a waterway between Lake Michigan and the Mississippi, ordered by act of Sept. 19, 1890. Made, 1891, under direction of Capt. Marshall, **91**, 2661.

Examination of the Upper Illinois River, and also Des Plaines River, Ill., with a view to extension of navigation from Illinois River to Lake Michigan at or near the city of Chicago ordered by act of June 3, 1896, made by Maj. Marshall, 1897 (report favorable), **97**, 2882.

MAPS:

**85**, 2054; **87**, 2124; **89**, 2122, 2134, 2140; **90**, 2613.

Of Illinois River at Bath Chute Bar and Fisher Island Bar, **78**, 1194.

## ILLINOIS RIVER, ILL., LOCKS AND DAMS (Operating and care). (See *Illinois River—Operations.*)

**Appropriations.**[a]

| | |
|---|---|
| 1890, | $7,176.96. |
| 1891, | 9,275.03. |
| 1892, | 8,004.06. |
| 1893, | 4,709.11. |
| 1894, | 14,500.73. |
| 1895, | 13,988.69. |
| 1896, | 14,382.03. |
| 1897, | 20,007.74. |
| 1898, | 13,567.68. |
| 1899, | 13,380.00. |
| 1900, | 12,225.15. |
| Total, | 131,217.18. |

**Commerce.**

Lockages: Lagrange lock only, increasing, **93**, 2830. Both locks increasing, but tonnage less, **94**, 2159; increasing, **95**, 2723; decrease, **96**, 2605; increase at Lagrange, decrease of passages at Kampsville but increased tonnage, **97**, 2822; increase, **98**, 2442.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 364; **94**, 335; **95**, 373; **96**, 328; **97**, 417; **98**, 406; **99**, 482; **1900**, 546.

ENGINEERS IN CHARGE:

Capt. W. L. Marshall, 1893–99. Reports, **93**, 2830; **94**, 2159; (Maj.), **95**, 2723; **96**, 2605; **97**, 2822; **98**, 2442; **99**, 2849.

Maj. J. H. Willard, 1899. Report, **1900**, 3805.

ASSISTANT. C. V. Brainard. Reports,

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[a] Expenditures under permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

**ILLINOIS RIVER, ILL., LOCKS AND DAMS (Operating and care)**—Continued.

**93**, 2831; **94**, 2161; **95**, 2724; **96**, 2606, **97**, 2823; **98**, 2445; **99**, 2852; **1900**, 3808.

**Operations.**

**1892–93.** Approaches to Lagrange lock kept dredged, and necessary repairs made, **93**, 2830.

**1893–94.** Headbay platform of Lagrange lock repaired and strengthened. 500 c. y. stone placed below dam to protect against scour. Drain built at Kampsville lock. Approaches to both locks kept dredged. **94**, 2159.

**1894–95.** 150 l. f. pile revetment built at Kampsville lock, and 140 c. y. riprap placed back of the revetment below the dam abutment. Miscellaneous work and repairs performed. **95**, 2723.

**1895–96.** Necessary repairs made. Fishways constructed at both locks. 8,807 c. y. dredged from entrance to Kampsville lock. Repair of plant commenced. **96**, 2605.

**1896–97.** Over 20,000 c. y. dredged from approaches. Repair of plant in progress. Miscellaneous work of repair and maintenance performed. **97**, 2822.

**1897–98.** About 6,000 c. y. filling placed. Repairs made to plant. Miscellaneous work of maintenance and repair performed. **98**, 2442.

**1898–99.** 3,021 c. y. dredged from Lagrange lock, and about 2,500 c. y. dredged from Kampsville lock. Miscellaneous work. **99**, 2849.

**1899–1900.** Ordinary work of maintenance, etc., **1900**, 3805.

**INDIANA CHUTE.** (See *Ohio River, Falls of.*)

**INDIANOLA HARBOR, TEX.** (See *Matagorda Bay; Pass Cavallo Harbor, Tex.*)

**INDIAN RIVER, DEL.** (See *Isle of Wight Bay.*)

**Appropriation.**

1882, $10,000, **83**, 651.

**Commerce.**

Prospective benefit of improvement to commerce, **88**, 745.

**Contract.**

**1883.** F. C. Somers, dredging, 34½ cents per c. y., **83**, 651.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 129; **82**, 127; **83**, 127; **84**, 135, 151; **85**, 131; **86**, 129; **87**, 91; **88**, 744.

ENGINEERS IN CHARGE:

(See *Surveys.*)

Capt. W. Ludlow, 1883. Reports, **82**, 828; **83**, 135.

Maj. W. H. Heuer, 1884–85. Report, **84**, 840.

W. F. Smith, U. S. agent, 1885–88. Reports, **85**, 881; **86**, 864; **87**, 835; **88**, 744.

ASSISTANTS:

E. Ludlow. Report, **82**, 830.

J. N. Odiorne. Reports, **83**, 651; **84**, 841.

**Operations.**

**1882–83.** 2,476 c. y. dredged, **83**, 650.

**1883–84.** 23,326 c. y. dredged, **84**, 841.

**Physical characteristics.**

Tides in Indian River and Rehoboth bays, **83**, 832.

Rainfall, **82**, 833.

**Projects.**

By Capt. Ludlow, 1882, improving river, mouth to Millsboro, by excavating channel through "Bulkhead" Shoal, 3,000 f. long, 80 f. wide, and 4 f. deep; thence to the inlet, 2,000 f. in length, 150 f. wide, and 5 f. in depth, channel to be protected by a dike on its north side. Estimate, $50,000. **82**, 833. Increased in 1883 to $60,000, **83**, 650; **87**, 835.

**Surveys.**

Ordered by act of Mar. 3, 1881, made, 1882, under direction of Col. Macomb, **82**, 829.

Examination of Isle of Wight and Upper Synepuxent bays, Md., and Indian River, Del., and intervening land, with a view to connecting their waters, ordered by act of Aug. 2, 1882, made, 1882, under direction of Lt. Col. Craighill, and adjudged by him as unworthy of improvement, **84**, 957.

# INDIAN RIVER, FLA., AND CONNECTING WATERWAYS.[a]

(See *St. Johns River.*)

## Appropriations.

| | | |
|---|---|---|
| 1844, | $1,500, | act June 15. |
| 1852, | 5,000, | act Aug. 30. |
| 1892, | 15,000, | **93**, 1657. |
| 1894–95, | 20,000, | **95**, 1545. |
| 1896, | 7,500, | **96**, 1320. |
| 1896, | 500, | **96**, 1319. |
| 1899, | 5,000, | **99**, 1609. |
| Total, | 54,500 | |

## Commerce.

Present and prospective commerce of the locality, **82**, 1242; **85**, 1291; **91**, 1674.

Jupiter Inlet of no particular value from a commercial point of view, **97**, 1568.

## Engineers.

CHIEF OF ENGINEERS. Reports, **66**, 7; **82**, 176; **84**, 194; **85**, 199; **87**, 162; **91**, 195, 1673; **93**, 203; **94**, 188; **95**, 213; **96**, 190; **97**, 242; **98**, 238; **99**, 273; **1900**, 312.

ENGINEERS IN CHARGE:

Col. Q. A. Gilmore. Reports, **82**, 1229; **84**, 1144.

Capt J. C. Post. Report, **84**, 1143.

Capt. W. Rossell. Report, **85**,1287, 1288.

Capt. W. M. Black, 1887–91. Reports, **87**, 1261; **91**, 1673.

Lt. A. M. D'Armit, 1893. Report, **93**, 1656.

Maj. T. H. Handbury, 1894–95. Reports, **94**, 1225; **95**, 1541.

Lt. Col. W. H. H. Benyaurd, 1896–98. Reports, **96**, 1318; **97**, 1554, 1568; **98**, 1333.

Capt. C. H. McKinstry, 1899. Report, **99**, 1608.

Capt. T. H. Rees, 1900. Report, **1900**, 1982.

ASSISTANTS:

J. F. Le Baron. Report, **82**, 1233.

A. W. Barber. Report, **85**, 1293.

Lt. D'Armit. Report, **94**, 1228.

J. W. Sackett. Report, **94**, 1229.

## Legal proceedings.

The Comptroller of the Treasury in 1896–97 decided that the appropriation of 1896 could not be used for the construction of a training wall at Negro Cut, **97**, 1554.

## Operations.[b]

**1894–95.** 56,665 c. y. dredged, **95**, 1542.

**1895–96.** 70,486 c. y. dredged, **96**, 1319.

**1896–97.** 23,097 c. y. dredged, **97**, 1554.

## Physical characteristics.

Description, **82**, 1234; **84**, 1146; **85**, 1288; **91**, 1674.

Description of, in the vicinity of Negro Cut, **94**, 1229; **95**, 1544, 1545; in the vicinity of Jupiter Inlet, **96**, 1319; **97**, 1568.

Borings, **94**, 1229.

## Plans. (See *Projects.*)

By Col. Gillmore, 1881, enlargement of the section of the existing canal from Mosquito Lagoon to Indian River to a width of 60 f. and a depth of 4½ f. Estimated cost, $66,000, **82**, 1231, 1232, 1238, 1241; **84**, 1143.

Modified in 1884 and estimate increased to $68,800, **84**, 1146; **85**, 1292.

By Capt. Rossell, 1884, improvement of the entrance to Mosquito Inlet, by the construction of two jetties at an estimated cost of from $500,000 to $750,000, **85**, 1290.

In 1887 Capt. Black did not consider the improvement of the channel from Haulover on Indian River to Gilbert's Bar worthy of improvement, **87**, 1261.

In 1891 Capt. Black reported the locality worthy of improvement on condition that the Florida Coast Line Canal & Transportation Co. surrender to the U. S. all rights held under State charter, **91**, 1675.

## Private (corporate) work.

The Florida Coast Line Canal & Transportation Co. up to 1892–93 had dredged 23 cuts across shoals in the river, making a continuous navigable channel 50 f. wide and 5 f. deep at l. w., **93**, 1656.

Description of the work done by the company, **96**, 1322.

## Projects. (See *Plans.*)

By Capt. Black in 1891, continuous channel 75 f. wide and 5 f. deep at l. w., except in the bends where various widths might be required, by widening the cuts of the canal company and making new cuts wherever needed; and for the removal of mangroves in the narrows, at an estimated cost of $44,000, no money to be expended until the canal company should surrender its charter rights along the route of the river, **93**, 1656, 1657. A project was submitted in 1894 for the expenditure of the appropriation of 1894 for the above work, the work to be done by the Government plant; project submitted by Maj. Handbury, **95**, 1544.

In 1893 Maj. Handbury estimated that it would cost $32,795 to make a channel 100 f. wide and 6 f. deep through Negro Cut, and for the construction of a training wall for its protection; and submitted

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[a] Indian River, Fla., to Mosquito Lagoon: Surveys—Reports, July 20, 1845, estimate $6,500; Jan. 6, 1856, estimate $5,000. (H. Doc. 482, 55th Cong., 2d sess.)

[b] History of previous operations toward the construction of a canal connecting Indian River with Mosquito Lagoon, **82**, 1229, 1233; **84**, 1143.

## INDIAN RIVER, FLA., AND CONNECTING WATERWAYS—Continued.

a project for the work, the Government plant to do the dredging required, **94**, 1228; **95**, 1545.

By Lt. Col. Benyaurd, 1896, making an opening at Jupiter Inlet 40 f. wide at bottom and 2 f. deep at l. w.; estimated cost, $500, **97**, 1554.

**Surveys.**

Between Indian Biver and Mosquito Lagoon ordered by act of July 14, 1880. Made under direction of Col. Gillmore, **82**, 1229.

Survey of same locality ordered by act of Aug. 2, 1882, made under direction of Col. Gillmore, **84**, 1143, 1144.

For line of inland communication from St. Johns River to Jupiter Inlet via Mosquito Lagoon, ordered by act of July 5, 1884, made under the direction of Capt. Rossell, **85**, 1291.

Of Mosquito Inlet ordered by act of July 5, 1884, made under the direction of Capt. Rossell, **85**, 1288.

Examination of channel from Haulover on Indian River to Gilbert's Bar ordered by act of Aug. 5, 1886, made under direction of Capt. Black, **87**, 1261.

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Capt. Black, **91**, 1673.

Examination under the direction of Maj. Handbury, made, 1893, authorized by resolution of the Senate of 1893, for the purpose of determining the cost of dredging a channel through Negro Cut, **94**, 1227, and again in 1897, by Lt. Col. Benyaurd (see *Projects*), **97**, 1568.

Examination of Jupiter Inlet made, 1896, by Lt. Col. Benyaurd, **96**, 1319.

Examination of Jupiter Inlet ordered by act of June 3, 1896, made, 1897, by Lt. Col. Benyaurd (report unfavorable), **97**, 1569.

## INWOOD. (See *Far Rockaway, N. Y.*)

## IOWA RIVER, IOWA.[a] (See *Des Moines and Iowa.*)

**Engineers.**

Chief of Engineers. Report, **84**, 244.

Engineer in Charge. Maj. A. Mackenzie. Report, **84**, 1591.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Maj. Mackenzie (report unfavorable), **84**, 1591.

## IPSWICH RIVER, MASS.

**Appropriations.**

1886, $2,500, **87**, 497.
1888, 2,500, **88**, 439.
1892, 2,500, **92**, 558.

Total, 7,500

**Commerce.**

Important, **74**, ii, 345, 346.

**Contracts.**

**1886.** T. Symonds, dredging, 31½ cents per c. y., **87**, 497.

**1892.** E. B. Lovering, dredging, 35 cents per c. y., removal of bowlders over 3 t. in weight, $7 (12,285 c. y.), **93**, 747.

**Engineers.**

Chief of Engineers. Reports, **73**, 106; **74**, 116; **76**, 48; **84**, 79; **87**, 24; **88**, 24; **89**, 34; **90**, 29; **91**, 35; **92**, 42; **93**, 40; **94**, 38; **95**, 41.

Engineers in Charge:

Lt. Col. Thom, 1872–76, and 1884. Reports, **74**, ii, 345; **76**, 198; (Col.), **84**, 557, 560.

Maj. C. W. Raymond. Report, **84**, 558.

Lt. Col. G. L. Gillespie, 1887–89. Reports, **87**, 495; **88**, 438.

Lt. Col. S. M. Mansfield, 1889–95. Reports, **89**, 559; **90**, 487; **91**, 631; **92**, 557; **93**, 746; **94**, 534; **95**, 603.

Assistant. S. Haagensen, **74**, ii, 345; **75**, 198. Reports, **74**, ii, 346; **76**, 200; **84**, 562.

**Operations.**

**1886–87.** 4,665 c. y. dredged from channel through shoals, **87**, 496.

**1892–93.** About 1,500 c. y. dredged, **94**, 535.

**1894–95.** About 5,700 c. y. dredged, **95**, 604.

**Estimates.** (See *Plans* and *Projects.*)

By S. Haagensen, 1872, for breakwater at Lower Plum Cove, $640,000; at Upper Plum Cove, $1,130,000, **74**, ii, 345.

By Lt. Col. Thom, 1875, for improvement of river by a channel 60 f. by 4 f., $25,000; for channel 60 f. by 9 f., $300,000, **76**, 199, 201, 202.

**Physical characteristics.**

Description, **74**, ii, 346; **76**, 199–201; **84**, 560, 563.

Character of coast, **74**, ii, 346.

Tidal observations, **74**, ii, 346; **76**, 200.

List of obstructions, **76**, 202.

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[a] Survey—Report Oct. 9, 1841, estimate, $32,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

## IPSWICH RIVER, MASS.—Continued.

**Plans.** (See *Estimates.*)

By S. Haagensen, 1873, for a breakwater at Lower Plum Cove, affording 23 acres of good anchorage ground of 18 f. depth, and 32 acres of 12 f. depth, at m. l. w., and 40 acres for small craft. Length of breakwater 1,841 f., to be constructed of riprap, stone masonry, and concrete. Favorably considered by Lt. Col. Thom; estimate, $640,000, **74**, ii, 345, 347. Or a breakwater at Upper Plum Cove, affording 30 acres more than the above. Length, 3,070 f.; estimate, $1,130,000; not recommended, **74**, ii, 345, 347. For improving river by a 9-f. channel at m. l. w., 60 f. wide; not recommended—too costly and not permanent, **76**, 199, 201.

By Lt. Col. Thom, for improvement at and above Barrass Turns by a 4-f. channel, at m. l. w., 60 f. wide; estimate, $25,000, **76**, 199, 201, 202.

**Projects.** (See *Estimates.*)

The original project for improvement was submitted Dec. 6, 1875. It proposed a channel 60 f. wide and 4 f. deep, m. l. w., from "Barras Turns" to the town wharves, at an estimated cost of $25,000. On Nov. 5, 1883, the original project was divided into three partial projects: (1) The removal of the ledges at Heards Point and opposite Nabbys Point to a depth of 2 f., m. l. w, to open a navigable channel of that depth, at a cost of $15,900; (2) to dredge the shoals at "Labor in Vain" and "The Shoals," so as to open a channel 4 f. deep at m. l. w., and 60 f. wide, at a cost of $2,200; (3) to straighten the channel by making a cut across "Barras Turns" and to build a jetty to close the old channel, at a cost of $6,900. In the annual report of 1887 it was recommended that the general project be modified by limiting the present improvement to opening a channel 60 f. wide and 4 f. deep through "The Shoals" and "Labor in Vain" and extending it to the "Deep Hole," opposite the town wharves, **88**, 438.

By Lt. Col. Mansfield, 1892, for the use of available funds to complete the partial projects of 1887, **93**, 746; Lt. Col. Mansfield estimated, 1895, that $17,500 would be required to complete the project, but that the amount of improvement already completed was sufficient for any reasonable demands of commerce, **95**, 604.

**Surveys.**

Survey by S. Haagensen, 1872, at Hodgkins Cove, to determine the practicability of a harbor of refuge, **73**, 106; **74**, 116, iii, 345, 346.

Survey of river completed by S. Haagensen, 1875, **76**, 48, 198, 200. Bench marks, **76**, 200.

Ordered by act of Aug. 2, 1882, made under the direction of Col. Thom, **84**, 557.

MAPS. **87**, 496.

## IRONDEQUOIT BAY, LAKE ONTARIO, N. Y.

**Commerce.**

That of adjacent ports not large enough to warrant improvement of the bay to make a harbor of refuge, **90**, 2854.

Description of, **95**, 3225.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 337; **90**, 2853; **95**, 424.

ENGINEERS IN CHARGE:

Capt. C. F. Palfrey. Report, **89**, 2425.

Maj. M. B. Adams, 1890. Report, **90**, 2854.

Capt. D. C. Kingman, 1895. Report, **95**, 3222.

**Physical characteristics.**

Description of. The bay is on the south side of Lake Ontario, about midway between the mouth of the Niagara River and the head of the St. Lawrence, is of irregular shape, extends inland for about 4 miles, and is separated from the lake by a bar at its mouth, the latter being about 6,000 f. wide, **95**, 3223.

**Plans.**

In 1889 Capt. Palfrey did not consider, in view of the neighborhood of Charlotte Harbor, that a harbor of refuge was a necessity at Irondequoit Bay, **89**, 2426.

**Surveys.**

Examination for harbor of refuge ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Palfrey (see *Plans*), **89**, 2425.

Special report on probable advantages of the bay as a harbor of refuge to aid the commerce of adjacent ports called for by House of Representatives, Apr. 5, 1890, made by Maj. Adams, 1890 (report unfavorable), **90**, 2853.

Examination for channel to connect with Lake Ontario ordered by act of Aug. 17, 1894, made, 1895, by Capt. Kingman (report unfavorable), **95**, 3222.

## IRON LAKE. (See *Port Wing, Wis.*)

**IRON RIVER, LAKE SUPERIOR, AND FLAG LAKE AND MOUTH OF FLAG RIVER, WIS.** (See *Port Wing Harbor, Wis.*)

**Commerce.**
Description of. Unimportant. **95**, 2581, 2582, 2583.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 352.
ENGINEER IN CHARGE. Maj. C. B. Sears, 1894–95. Report, **95**, 2580.

**Physical characteristics.**
Description of, **95**, 2581, 2582.
Iron River, and Flag Lake and river within 6 miles of each other, **95**, 2581.
The mouth of Iron River is on the south shore of Lake Superior and distant from Duluth 29 miles easterly; a small stream about 18 miles long, dammed for log storage about 800 f. above its mouth, **95**, 2581.
Flag Lake and mouth of Flag River are located about 34 miles from Duluth easterly; river about 13 miles long, the lake is a slough of the river about 1½ miles long, with an average width of 300 f., **95**, 2582.

**Private work.**
*Iron River:* The river enters Lake Superior between two rough, round, timber-crib piers built by a sandstone company, **95**, 2581.
*Flag River:* Two rough timber cribs were built at the mouth by a private company some time previous to the examination of 1894, **95**, 2582.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made, 1894, by Maj. Sears (report unfavorable) **95**, 2580.

**IRONTON, OHIO.** (See *Ohio River.*)

**ISLAIS CREEK (San Francisco Bay), CAL.**

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 2340.
ENGINEER IN CHARGE. Lt. Col. G. H. Mendell. Report, **85**, 2340.

**Obstructions.**
In 1884, bridge obstructed navigation, **85**, 2341.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Col. Mendell (report unfavorable), **85**, 2340.

**ISLE OF WIGHT BAY, UPPER SYNEPUXENT BAY, AND INDIAN RIVER.** (Connection of.)

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 151.
ENGINEER IN CHARGE. Capt. T. Turtle. Report, **84**, 957.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Turtle (report unfavorable), **84**, 957.

**ISLE ROYALE.** (See *McCargoes Cove, Mich.*)

**ISLES OF SHOALS, ME. AND N. H.** (See *Portsmouth Harbor, N. H.*)

**Appropriations.**
1821,[a] $2,500 (surveys), act, Mar. 3.
1822,[a] 11,500, act, May 7.
Total, 14,000

**Commerce.**
Description of, **1900**, 1172.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 62; **1900**, 77.
ENGINEERS IN CHARGE:
Maj. S. W. Roessler, 1900. Report, **1900**, 1172.
Maj. W. L. Fisk, 1900. Report, **1900**, 1175.
ASSISTANT. Lt. C. Keller. Report, **1900**, 1174.

**Physical characteristics.**
Description of, **1900**, 1175.

**Project.**
Maj. Fisk, 1899, estimated it would cost $30,000 for new breakwater, **1900**, 1176.

**Surveys.**
Examination between Smutty Nose and Cedar Islands, ordered by act of Mar. 3, 1899, made under direction of Maj. Roessler, 1899 (report favorable), **1900**, 1172.
Survey ordered by act of Mar. 3, 1899, made, 1899, by Maj. Fisk (see *Projects*), **1900**, 1176.

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[a] Authority: H. R. Doc. No. 482, 55th Cong., 2d sess.

## ISLIP, N. Y. (*See Champlins Creek.*)

## IRRIGATION. (See *Wyoming and Colorado.*)

## JACKSON. (See *Pearl River, Miss.*)

## JACKSONS CREEK, VA.

**Commerce.**

In 1894 it amounted to about 7,000 tons of oysters, etc., which would probably be doubled by an improvement, **95**, 1262. The limited interests involved would not justify an expenditure of the necessary large amount to obtain permanent improvement, **95**, 1263.

Description of, **1900**, 1753, 1754.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 167; **99**, 223; **1900**, 254.

ENGINEERS IN CHARGE:

Maj. C. E. L. B. Davis, 1892–95. Report, **95**, 1261.

Lt. Col. C. J. Allen, 1900. Report, **1900**, 1753.

**Physical characteristics.**

Description of, **95**, 1262; **1900**, 1753.

**Surveys.**

Examination near the mouth of the Piantatank River ordered by act of Aug. 17, 1894, made, 1894, by Maj. Davis (report unfavorable), **95**, 1261.

Examination with view to removal of bar at mouth of Jacksons Creek ordered by act of Mar. 3, 1899, report submitted, 1899, by Lt. Col. Allen (report unfavorable), **1900**, 1753.

## JAMAICA BAY. (See *Cornells Creek and Landing to, N. Y.*)

## JAMAICA BAY TO LONG BEACH INLET, N. Y.

**Appropriation.**

1892, $9,460, **93**, 1070.

**Contract.**

**1892.** E. Brainard, dredging, 25⅛ cents per c. y. ($8,542.50), **93**, 1070.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **92**, 97; **93**, 103; **94**, 93; **95**, 106.

ENGINEER IN CHARGE. Lt. Col. G. L. Gillespie, 1892–95. Reports, **92**, 840, 845; **93**, 1069; **94**, 779; **95**, 958.

ASSISTANT. G. W. Kuehule. Report, **92**, 847.

**Operations.**

**1892–93.** 13,845 c. y. dredged, **93**, 1069.

**1893–94.** 20,174 c. y. dredged, **94** 780.

**Physical characteristics.**

Description of, **92**, 841.

**Projects.**

By Lt. Col. Gillespie, 1891, excavation of a navigable waterway 60 f. wide and 5 f. deep at m. l. w. from Beach Channel to some point on the eastern shore of Jamaica Bay; three routes are submitted, at a cost, respectively, of $21,406, $18,920, and $9,460, **92**, 846, 847; **93**, 1069.

**Survey.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Lt. Col. Gillespie, **92**, 845.

## JAMAICA BAY TO ROCKAWAY INLET, N. Y. (Channel.)

**Commerce.**

Value of oyster trade, **87**, 755.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 67.

ENGINEER IN CHARGE. Lt. Col. W. McFarland, 1886. Report, **87**, 754.

ASSISTANT. M. Kingsley. Report, **87**, 756.

**Physical characteristics.**

Description, **87**, 754.

**Survey.**

Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. McFarland (report unfavorable—cost too great), **87**, 754.

## JAMES CREEK CANAL, D. C.

**Engineers.**
CHIEF OF ENGINEERS. Report, **88**, 107.
ENGINEER IN CHARGE. Lt. Col. P. C. Hains, 1887. Report, **88**, 807.

**Physical characteristics.**
Description of, **88**, 807.

**Plans.**
By Lt. Col. Hains, 1887, for filling in low areas, and constructing retaining walls, vicinity of Washington Barracks, at estimated cost $226,270 to $514,000, **88**, 809, 811.

**Survey.**
Survey made, 1887, under direction of Lt. Col. Hains (See *Plans*), **88**, 807.
MAPS. **88**, 810.

**JAMES RIVER.** (See *Great Kanawha River, W. Va.; Transportation Routes to the Seaboard.*)

## JAMES RIVER, N. DAK. AND S. DAK.

**Commerce.**
Unimportant, 1893, **93**, 2321-2325.

**Documents.** (Not printed in reports.)
H. Doc. 75, 43d Cong., 2d sess. Report on result of survey, **75**, 367.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **75**, 63; **87**, 217; **93**, 297.
ENGINEERS IN CHARGE.
Maj. F. U. Farquhar, 1874-75. Report, **75**, 367.
Capt. C. B. Sears, 1886-87. Report, **87**, 1603.
Capt. H. F. Hodges, 1892-93. Report, **93**, 2321.
ASSISTANTS.
M. Schmidt, **75**, 367.
D. H. Ainsworth, **75**, 365.
F. M. Towar. Report, **93**, 2325.

**Physical characteristics.**
Description, **75**, 367-369; **87**, 1603; **93**, 2321.
Channel very tortuous, **87**, 1606.
Insufficient volume of water for light-draft streamers, **75**, 369, 370; **87**, 1606; **93**, 2321.

**Plans.**
The improvement of river very difficult on account of a lack of water, and only to be determined by a careful survey, **75**, 369, 370.
In 1886 Capt. Sears reports that the river can not be made navigable by the ordinary means of improving the natural channel for the reasons that there is not a sufficiency of water and that the channel is too tortuous, **87**, 1606.

**Surveys.**
1874. Examination by D. H. Ainsworth and M. Schmidt from Northern Pacific R. R. to Southern Dakota R. R. (see *Plans*), **75**, 63, 367.
Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Capt. Sears (see *Plans*), **87**, 1603.
Examination ordered by act of July 13, 1892, made under direction of Capt. Hodges, 1893 (report unfavorable), **93**, 2321.

**JAMES RIVER AND KANAWHA CANAL. (Survey for extension of.)**[a] (See *Transportation routes, third subdivision, central route;* also *Great Kanawha River.*)

**Commerce.**
Importance of improvement, **71**, 625, 626, 629, 636, 644, 646; **73**, 832; **74**, ii, 91, 102, 114, 123.
Superiority of canals as great freight highways, **71**, 628, 630, 632, 644, 647; **73**, 832, 834; **74**, ii, 123; **75**, ii, 637; cost of transportation by, **71**, 630, 632, 639, 644; **73**, 833; **74**, ii, 111, 123; application of steam on, **73**, 833.
Distances from Richmond to Ohio River, **71**, 635, 650; **73**, 830, 833; **77**, 677.
Comparison of route with Chesapeake and Ohio Canal, **77**, 677, 682.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **70**, 69; **71**, 76; **72**, 74; **73**, 78; **74**, 89.
BOARD OF ENGINEERS:
1874. To determine and report, in the project for connecting the navigable waters of the James and Ohio rivers, as to practicability, plan, cost, and probable time of execution, and benefits to commerce to be derived therefrom, **74**, 89, ii, 86, 124. Conclusions. It is entirely practicable to connect said rivers by water navigation 7 f. in depth, involving the enlargement of existing canal on James River and its extension to the Greenbrier River, together with the construction of summit tunnel, and water supply for summit level, and the extension of water communication from Greenbrier River to the mouth of the Great Kanawha River, **74**, ii, 89, 94, 115, 121, 129; **77**, 677. Con-

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[a] Survey—Report Mar. 24, 1828, H Doc. No. 482, 55th Cong., 2d sess.

**JAMES RIVER AND KANAWHA CANAL. (Survey for extension of)**—Continued.

cerning the plan, minor differences of opinion exist as to dimensions and arrangement of locks on that portion which shall be canal, i. e., from Richmond to Greenbrier River, majority favoring increased lock dimensions both on canal and slack-water improvement; suggest further examinations for location of tunnel, **74**, ii, 90, 93, 111, 117, 129; **75**, ii, 630, 632; **77**, 675. Unanimously recommend single tunnel 34 f. by 34 f. with recesses for passing boats, **74**, ii, 90, 100, 128; **77**, 685. Concerning improvement of Greenbrier, New, and Kanawha rivers by locks and dams, a difference of opinion exists as to its applicability, requiring further surveys to finally adjust, **74**, ii, 91, 93, 97, 112, 117, 119, 121, 128; **75**, ii, 632. Cost and probable time of execution: In the opinion of the majority, a water communication, with a depth of 7 f., can be obtained at a cost not exceeding $60,000,000 in about six years, **74**, ii, 91, 92, 101, 113, 120, 122, 129; **75**, ii, 637; **77**, 677. Benefits to commerce: In general terms, the route presents extraordinary claims as a measure of relief to the Western States and as a means of developing immense mineral resources now neglected, **74**, ii, 91, 95, 102, 109, 113, 114, 123, 128. (See *Projects.*)

(Col. Barnard, Majs. Craighill and Weitzel, B. H. Latrobe, and Lt. Turtle, **74**, ii, 92, 124.)

Supplementary reports: Col. Barnard, **74**, ii, 91, 97; B. H. Latrobe, **74**, ii, 97, 102; Lt. Col. Gillmore, **74**, ii, 102, 114; Maj. Craighill, **74**, ii, 114, 121; Maj. Weitzel, **74**, ii, 121, 134.

ENGINEER IN CHARGE: Maj. W. P. Craighill, 1870–74; **70**, 68. Reports, **71**, 620, 624; **73**, 828; **74**, ii, 114.

ASSISTANTS:

W. R. Hutton, **71**, 76, 620, 624; **75**, ii, 633. Report, **71**, 634.

W. G. Turpin, **71**, 76, 620, 624. Report, **71**, 650.

E. Lorraine, **71**, 620, 634; **73**, 78, 828.

J. M. Harris Report, **73**, 828.

R. B. Pegram, **73**, 828.

Lt. T. Turtle, **75**, ii, 632.

**Estimates.** (See *Plans* and *Projects.*)

For enlargement of existing canal from Richmond to Buchanan, and extension to mouth of Fork Run, $14,781,644, **71**, 627; **73**, 830; **74**, ii, 101, 654; **77**, 676. From Fork Run to tunnel, $2,383,447, **71**, 627, 648. Tunnel, $13,263,310, **71** 627, 648. Greenbrier and New rivers, $13,243,541, **71**, 627, 648. Kanawha River, $973,900, **71**, 627, 642, 650. Contingencies, 10 per cent, $2,986,420, **71**, 627, 650. Aggregate, $47,622,262, **71**, 627; **73**, 830; stated at $50,000,000, **71**, 628; **73**, 829; **74**, ii, 120.

Revised estimate, 1873, $50,960,636, **73**, 830.

Board of Engineers, 1874, consider that the connection between James and Ohio rivers would not exceed $60,000,000, **74**, ii, 91, 92, 101, 113, 120, 122, 129; **75**, ii, 636; **77**, 677.

By B. H. Latrobe, after modifying tunnel section and adjusting prices therefor, $49,626,845, **74**, ii, 101.

**Physical characteristics.**

Of New River, **71**, 640; discharge of, **71**, 641; high water on, **71**, 641; **73**, 831; **74**, ii, 94.

Of Greenbrier River, **71**, 641; discharge of, **71**, 641; **73**, 831; high water on, **71**, 641; **73**, 831; **74**, ii, 94.

**Plans.** (See *Estimates.*)

Early plans, 1817–19, contemplated a navigation of rivers, east and west of the Alleghanies, by batteaux of 2 or 3 f. draft, and passage of mountains by turnpike road, **71**, 625, 636.

Capt. McNeil, 1826–28, submitted to board of internal improvement a plan for improving James, Jackson, Greenbrier, New, and Kanawha rivers, by slack-water navigation and canal, passing the Alleghanies by tunnel 2.6 miles in length, **71**, 625, 634, 637; **74**, ii, 87; **77**, 677, 762.

The James River & Kanawha Canal Co., 1832–36, began the construction of works, looking to the connection between James and Ohio rivers. (See *Private and corporate work.*)

For further plans, see *Kanawha River.*

**Private (corporate) work.**

**1785.** A company was organized for improvement of James River, which, in 1832, transferred all its rights and franchises to the James and Kanawha River Canal Co., who, in 1836, began the construction of the James River and Kanawha Canal, the proposed route of which was as follows: From Richmond up valleys of James and Jackson rivers to Covington; thence, via Dunlaps Creek and Fork Run, to summit level; thence by tunnel 2.6 miles; thence, via valleys of Howard Creek, Greenbrier, New, and Kanawha rivers, to the Ohio; total distance, 486 miles. In 1872 the portion from Richmond to Buchanan had been completed, of which 159.7 miles was canal and 36.7 miles slackwater; canal dimensions, 50 f. by 5 f.; locks, 100 f. by 15 f. by 5 f., **71**, 625, 635, 650, 651.

**1868.** E. Lorraine advised new line for tunnel, reducing summit level 216 f., but increasing length of tunnel to 9 miles, **71**, 626. Legislation concerning duties, rights, and franchises of company, **77**, 808. Kanawha River Improvement Co. (See *Kanawha River.*) Chesapeake and

**JAMES RIVER AND KANAWHA CANAL. (Survey for extension of)**—Continued.

Ohio R. R.; the location of, adds greatly to estimated cost of water communication, **71**, 643; **73**, 829; **77**, 677.

**Projects.**

By Maj. Craighill, 1871–73, for connecting the James and Ohio rivers by a water navigation 7 f. in depth, as follows: By enlargment of existing works of the James River and Kanawha Canal Co. from Richmond to Buchanan, 196½ miles; thence, via valleys of James and Jackson rivers, Dunlap Creek, and Fork Run, to summit level, passing summit, 1,700 f. above tide, by tunnel 7.8 miles in length (tunnel section double 52 f. by 34.5 f.); thence down Howard Creek to Greenbrier River, or a distance of 77.6 miles from Buchanan (canal section 70 f. by 7 f., locks 120 f. by 20 f. by 7 f.); thence via Greenbrier, New, and Kanawha rivers to Paint Creek Shoals, 123 miles, by slackwater navigation, with occasional short reaches of canal, to avoid expensive locations for dams (locks and dams of masonry, locks 240 f. by 40 f.); thence via Kanawha to its mouth, 79 miles, by open navigation of low-water dams provided with sluices, low-water depth to be aided by reservoirs on Anthony Creek and Meadow River; estimated cost, $50,000,000 (see *Estimates*), **71**, 625, 635, 637, 650; **73**, 829; **74**, ii, 88, 100, 117, 128; **77**, 754.

Projects submitted, 1874, to Board of Engineers for conclusions and recommendations concerning. (See *Board of Engineers.*)

**JAMES RIVER, VA.**[a]

**Appropriations.**

1836, $500 (survey), act July 4.
1852, [b] 22,500, act Aug. 30.
1870, 50,000, **70**, 68; **71**, 73, 597; **74**, ii, 39.
1871, 50,000, **71**, 73, 597, 605; **74**, ii, 39.
1872, 50,000, **72**, 70, 691; **74**, ii, 39.
1873, 75,000, **73**, 75; **74**, ii, 39.
1874, 50,000, **74**, 86, ii, 39; **77**, 285.
1875, 50,000, **75**, 88, ii, 73; **77**, 285.
1876, 60,000, **76**, 65, 140, 291; **77**, 60, 285.
1878, 70,000 **78**, 66, 454.
1879, 75,000, **79**, 78, 513.
1880, 75,000, **80**, 648.
1881, 60,000, **81**, 892.
1882, 75,000, **82**, 860.
1884, 75,000, **84**, 905.
1886, 112,500, **86**, 890.
1888, 225,000, **88**, 762.
1890, 200,000, **90**, 992.
1892, 200,000, **92**, 1013.
1894, 100,000, **95**, 1183.
1896. 120,000, **96**, 1008.
1899, 150,000, **99**, 1438.

Total, 1,945,500

**Commerce.**

Importance of improvement, **73**, 778; **74**, ii, 43, 45; **75**, ii, 83; **77**, 290.

Improved condition of river, **74**, 85, ii, 45; **75**, ii, 81, 83; **76**, 293; **77**, 60, 284, 288; **79**, 513.

Previous condition of, **76**, 293; **79**, 513.

Vessels to Richmond obliged to transfer part of cargoes, **74**, ii, 45.

Time saved by use of Dutch Gap and other cut-offs, **73**, 75, 774, 776, 777; **76**, 305; **79**, 513.

**Contracts.**

**1870–71.** B. Maillefert, removing wrecks, remains of military bridges, and other obstructions, **71**, 73, 597; successful work of, **72**, 69, 690. Kalmback & Barton, excavating rock at Rockett's Reef, **71**, 73 598; failure to complete work, and contract annulled February, 1872, and carried on by hired labor, **72**, 69, 691; **73**, 776.

**1871–72–75.** American Dredging Co., dredging at Dutch Gap cut-off, **71**, 73, 598; **72**, 69, 690; **75**, ii, 73; **79**, 516.

**1875.** R. T. Hieston, dry excavation at Dutch Gap cut-off and construction of dikes, **75**, ii, 73, 83; **76**, 291; contract completed February, 1876, **76**, 292.

**1876.** M. Meehan, dredging Dutch Gap cut-off, **75**, ii, 73, 83; **76**, 291; contract completed February, 1876, **76**, 292.

**1878.** M. C. Heggarty, for excavation at Dutch Gap, **79**, 515. Comparison of prices by contract and hired labor, **74**, ii, 42.

**1879.** J. Caler, dredging, 16 and 14$\frac{1}{10}$ cents per c. y., **80**, 649.

**1880.** G. H. Ferris, dredging, 23 cents per c. y. J. Caler, dredging, 15 and 17 cents per c. y. **81**, 892.

**1884.** D. Constantine, dredging, 11 cents per c. y., **85**, 945.

**1886.** J. Caler & Son, dredging, 12½ cents per c. y., **87**, 868.

**1887.** J. F. Gaynor, construction of jetties and dikes. G. E. Ward, dredging. J. L. Wilson, rock removal. **87**, 870.

**1888.** American Dredging Co., dredging, 16 cents per c. y. Alabama Dredging and Jetty Co., rock removal, $1.50 per c. y. for disintegrated and $6.33 per

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[a] Survey—Report Jan. 25, 1837, estimate $115,200. Examination—Report (favorable) Nov. 26, 1852. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Half of $45,000 for James and Appomattox rivers below Richmond and Petersburg.

## JAMES RIVER, VA.—Continued.

c. y. for solid rock. **89**, 935. John F. Gaynor, mattress-dike construction, $2.47 and $1.75 per l. f.; jetty construction, $2.47 per l. f. H. T. Morrison, construction of four scows, $4,385. H. T. Morrison, construction of lighter, $1,476.50. **89**, 936. J. F. Bradley, brush-dike construction, 95 cents per l. f., **89**, 937.

**1889.** Wm. T. Gaynor, brush-dike construction, $1.50 per l. f., **90**, 993.

**1890.** H. Brusstar & Bro., construction of scow, $1,305, **90**, 994. W. H. Curtis, mattress construction, $1.79 per l. f., jetty construction, $2.49 per l. f. C. D. Langhorne, removal of disintegrated rock, 45 cents and $1.45 per c. y.; removal of solid rock, $1.10 and $6.15 per c. y.; gravel excavation, 16 cents and 25 cents per c. y. **91**, 1236. C. T. Caler, dredging, 38 cents per c. y. for disintegrated rock, 16½ cents for sand, and $1.04 per c. y. for solid rock removal, **91**, 1237.

**1891.** J. T. Vaughan, dredging, 44 cents per c. y. for sand, $3 for bowlders, and $1 per l. f. for logs, **91**, 1237. C. D. Langhorne, construction of railroad track, $5,350, and transfer slip, $3,000; Tredegar Co., construction of one car, $325; H. T. Morrison & Co., caisson construction, $2,476, **92**, 1013.

**1892.** Brusstar Shipbuilding Co., one scow, $971.50, **93**, 1255. J. A. Curtis, excavating, 16 cents to $5.50 per c. y., dike and dam construction ($137,061), **93**, 1252–1254.

**1894.** P. Sanford Ross, excavation, 12 cents to $5 per c. y. ($59,736.05), **95**, 1184–1186.

**1895.** J. A. Curtis, excavation, 20 cents to $2 per c. y., furnishing, driving, and fastening piles and piling; brush and brush mats; stone or coarse gravel ($20,233.76), **96**, 1009.

**1897.** P. S. Ross, dredging, 25 cents to $4.70 per c. y.; piles and sheet piling ($21,003), **98**, 1212.

**1899.** P. S. Ross, earth excavation and removal of cobbles and hard rock, 25 cents to $4.45 per c. y. ($84,459.19), **1900**, 1727.

**Defense.**

Operations at Dutch Gap Canal by Gen. Butler, **71**, 603; **72**, 691; **75**, ii, 82; **79**, 516.

Obstructions placed in river during the rebellion, **70**, 68; **71**, 603, 605; **76**, 293; **77**, 287; **79**, 512, 515.

**Documents.** (Not printed in reports.)

S. Doc. 1, 33d Cong., 1st sess., **71**, 603.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 68; **71**, 73, 76; **72**, 70; **73**, 75, 78; **74**, 85, 89; **75**, 88; **76**, 64; **77**, 60; **78**, 65; **79**, 77; **80**, 105; **81**, 141, 150; **82**, 137, 144; **83**, 141; **84**, 146; **85**, 142; **86**, 137; **87**, 100; **88**, 97; **89**, 113; **90**, 103, 333; **91**, 134; **92**, 134; **93**, 142; **94**, 133; **95**, 154; **96**, 139; **97**, 187; **98**, 190; **99**, 220, 223; **1900**, 251, 255.

BOARD OF ENGINEERS. Convened Mar. 17, 1890, at Richmond, to consider and report upon the establishment of harbor lines in James River. Report, **90**, 1013, 1016. Harbor lines as established by the board, **90**, 1016. (Col. Craighill, Lt. Col. Hains, and Lt. Fiebeger.)

ENGINEERS IN CHARGE:

Maj. W. P. Craighill, 1870–84; **70**, 68. Reports, **71**, 597, 624; **72**, 690; **73**, 774, 828; **74**, ii, 38; **75**, ii, 72; **76**, 290; **77**, 284; **79**, 512; (Lt. Col.), **80**, 647; **81**, 891; **82**, 860; **83**, 683; **84**, 904.

Capt. C. B. Phillips, temporarily in charge, **78**, 63, 445. Report, **78**, 453.

Lt. Col. P. C. Hains, 1884–87. Reports, **85**, 944; **86**, 887; **87**, 867.

Col. W. P. Craighill, 1888–94. Reports, **88**, 761; **90**, 992, 1013; **91**, 1234; **92**, 1012; **93**, 1251; **94**, 915.

Capt. Thos. Turtle, 1889–90. Report, **89**, 934.

Lt. Col. P. C. Hains, 1895–96. Reports, **95**, 1182; (Col.), **96**, 1007.

Lt. Col. Chas. J. Allen, 1897–. Reports, **97**, 1346; **98**, 1209; **99**, 1436; **1900**, 1725, 1754, 1757.

ASSISTANTS:

W. G. Turpin. Reports, **73**, 776; **74**, ii, 41.

H. D. Whitcomb. Reports, **75**, ii, 80, 82; **76**, 291; **77**, 285; **78**, 455; **79**, 515; **80**, 648, 649; **81**, 892; **82**, 887; **92**, 1014; **93**, 1255; **94**, 916; **95**, 1187; **96**, 1010; **98**, 1213.

W. Popp. Report, **75**, ii, 74.

G. R. Talcott, **76**, 301.

Capt. T. Turtle. Reports, **82**, 861, 872; **83**, 684.

C. P. E. Burgwyn. Reports, **82**, 878; **84**, 905; **85**, 948; **87**, 870; **88**, 762; **89**, 937; **90**, 994; **91**, 1237.

S. H. Yonge. Reports, **99**, 1439; **1900**, 1729, 1759.

**Estimates.** (See *Projects.*)

Maj. Craighill, 1870, improvement from canal locks (Richmond) to and below Goose Hill Flats, by dredging, diking, and rock excavation, as follows, depths (at high tide): Via Trents Reach, channel 180 f. by 15 f., $125,000; via Trents Reach, channel 180 f. by 18 f., $270,000; via Dutch Gap Canal, channel 180 f. by 15 f., $120,000; via Dutch Gap Canal, channel 180 f. by 18 f., $250,000, **71**, 73, 604, 606; **72**, 691; **74**, ii, 39, 41.

Increased prices required, 1874, estimate to be revised: For channel 180 f. by 15 f.,

**JAMES RIVER, VA.**—Continued.

via Dutch Gap, $117,000; channel 180 f. by 18 f., via Dutch Gap, $408,925, **74**, 85, ii, 39, 41; **75**, ii, 72; **76**, 65, 291; **77**, 285.

Revised, 1876, for channel 180 f. by 15 f. at m. l. w. from canal locks (Richmond) as far as Harrisons Bar, with partial improvements thereon, $293,808, **76**, 65, 291, 300.

Foregoing revised, 1877; amount required to complete existing project, $258,024, **77**, 60, 285, 289.

H. D. Whitcomb, 1879, revised to include enlarging and deepening Dutch Gap Cut-off, and increasing depth over shoals below and over Varina or Aikens Bar, $161,000, exclusive of appropriation for 1879, **79**, 78, 513, 520.

**Obstructions.**

Wrecks, remains of military bridges, etc., placed during the war, **70**, 68; **71**, 73, 597, 603; **76**, 293; **79**, 512.

**Operations.**[a] (See *Private and corporate work.*)

**1870–71.** Removal of wrecks; remains of military bridges; opening Dutch Gap Cut-off to 100 f. by 18 f. (high water); rock excavation Rocketts Reef 125 f. by 18 f. (high water), **71**, 73, 597, 598, 600. Operations required, **71**, 603, 605.

**1871–72.** Removal of obstructions at Drewry Bluff; Dutch Gap Cut-off opened to width of 135 f.; failure of contractor on Rocketts Reef (Feb., 1872); work thereafter done by hired labor; dredging by city of Richmond, **72**, 69, 690; **73**, 776.

**1872–73.** Continuation of rock excavation at Rocketts Reef and vicinity by hired labor; details of drilling and blasting at; construction of dikes; dredging by U. S. and city of Richmond, **73**, 75, 774, 776. Transferment Jan. 1, 1872, by city of dredging plant to U. S., **73**, 777. Details of transfer, **74**, ii, 41.

**1873–74.** Removal of rock from channel near Richmond, especially at Rocketts Reef; dredging on bars and depositing material behind rectifying and contracting dikes, **74**, 85, ii, 38, 41. All work done by hired labor; advantages of, **74**, ii, 42. Success of work done, **74**, ii, 43.

**1874–75.** Removal of rock from channel near Richmond, and especially at Rocketts Reef; dredging on bars and depositing material behind rectifying and contracting dikes, **75**, 88, ii, 72, 81. Arrangement between city of Richmond and U. S. (as to use by latter of dredging plant) canceled May 1, 1875, **75**, ii, 81. Cooperation of city with U. S. in dredging, **75**, 88. General progress of work, **75**, ii, 81. Present depth, **75**, ii, 83. All work done by hired labor, **75**, 88, ii, 81, 83.

**1875–76.** Excavation of Dutch Gap Cut-off and construction of dikes by contract; removal of rock on Rocketts Reef and elsewhere; dredging from bars and depositing behind dikes by hired labor, **76**, 64, 291. Rental from city of Richmond of part of machinery and dredging plant; rent not to exceed cost of repairs to city, **76**, 64, 291. Cooperation of city with U. S.; amount of work done, **76**, 292.

**1876–77.** Rock excavation; dredging and deposition of material behind dikes; construction of dikes carried on by hired labor; timber for dikes furnished by contract; continued use by U. S. of machinery belonging to city of Richmond on basis of previous year; cooperation of city; general progress, **77**, 60, 284, 285. Cost of dredging, 33½ cents per c. y.; of rock removed, $7.54 per c. y.; construction of timber groins (dikes), $1.46 per l. f., **77**, 286. Present minimum depth from above Rocketts Reef to sea, 14.2 f., **77**, 288.

**1877–78.** Continuation of work by hired labor and use of dredging machinery belonging to city of Richmond on basis of rental of previous year; cooperation of city of Richmond with U. S. in dredging operations, **78**, 65, 453, 455. Present condition of channel, **78**, 457, 458.

**1878–79.** Continuation of work by hired labor in rock removal, dredging, and construction of wing dams; history of past operations; present condition of channel, **79**, 78, 512, 515, 516, 517.

**1879–80.** 175,593 c. y. removed and 4,621 l. f. wing dams built by U. S.; 48,999 c. y. removed and 396 l. f. wing dam built by city of Richmond, **80**, 647.

**1880–81.** Rock removal and 190,424 c. y. dredged by U. S. and 57,847 c. y. by city of Richmond; 4,463 l. f. wing dams built by U. S., **81**, 894.

**1881–82.** 126,826 c. y. removed, 2,005 l. f. wing dams and 350 l. f. fascine work constructed, **82**, 863.

**1882–83.** 44,340 c. y. sand and 227 c. y. rock removed by city of Richmond, **83**, 685.

**1883–84.** Rock removal continued, **84**, 905.

**1884–85.** 307 l. f. of jetty and 2,609 l. f. brush dike built, 1,100 c. y. solid rock blasted and dredged, **85**, 949, 950. 46,750 c. y. dredged, **85**, 951. 153,191 c. y. dredged, **85**, 945; 16,400 c. y. removed by city of Richmond and railroad companies, **85**, 954.

**1885–86.** 122,320 c. y. sand and

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[a] Previous to 1870 consisted of dredging and removal of bowlders, cooperating with city of Richmond; defect in previous dredging, 71, 603.

## JAMES RIVER, VA.—Continued.

1,240 c. y. rock and gravel dredged from channel, **86**, 889.

**1886–87.** 20,670 c. y. sand and gravel and 97 bowlders removed from Kingsland Reach; 862 c. y. dredged at Randolph Flats and 981 l. f. of jetty built; 635 c. y. rock removed at Goodes Rocks, **87**, 870, 872.

**1887–88.** 120,566 c. y. of sand and gravel, 220 bowlders, and 7,064 c. y. solid rock removed; 10,047 l. f. of training wall, 2,066 l. f. of new wing dam, and 1,016 l. f. of old wing dam built, **88**, 762–765.

**1888–89.** 509,078 c. y. dredged, 4,380 c. y. rock removed, and 8,379 l. f. of training wall built, **89**, 938.

**1889–90.** 8,860 c. y. rock removed; 78,336 c. y. dredged; 9,340 l. f. training wall built, **90**, 994, 997.

**1890–91.** 66,700 c. y. rock removed; wing dam built at Wilton; 39,970 c. y. dredged at Kingsland, and 2,900 f. of training wall built, **91**, 1241.

**1891–92.** 101,825 c. y. dredged; 20,058 c. y. loose rock and 6,265 c. y. solid rock removed, **92**, 1016.

**1892–93.** 18,217 c. y. earth excavated, 1,286 c. y. cobbles, 33,164 c. y. soft rock, 3,073 c. y. loose stone, 447 l. f. brush wall constructed, and 2,824 l. f. of wing dams constructed and extended, **93**, 1257.

**1893–94.** 15,590 c. y. earth excavated, 130 c. y. cobbles, 13,234 c. y. soft rock and 4,302 c. y. solid rock removed; 7,140 l. f. of wing dams constructed and 531 l. f. repaired, **94**, 920.

**1894–95.** Model of river and adjacent country sent to Willets Point school of application, **95**, 1187. 179,671 c. y. earth excavated, 530 c. y. of cobbles, 3,770 c. y. soft rock, and 6,963 c. y. solid rock removed, **95**, 1190.

**1895–96.** 44,778 c. y. earth excavated, 2,289 c. y. cobbles, 7,512 c. y. soft rock, 10,392 c. y. solid rock removed; 1,296 l. f. new dams constructed and 486 l. f. extended; over 698 l. f. dike constructed, **96**, 1013.

**1896–97.** 24,037 c. y. earth excavated, 1,827 c. y. cobbles, 26,498 c. y. soft rock, and 6,878 c. y. solid rock removed; 2,738 l. f. wing dams constructed, **97**, 1347.

**1897–98.** 2,926 c. y. earth excavated, 362 c. y. cobbles, 7,024 c. y. soft rock, and 3,387 c. y. solid rock removed, and about 1,690 l. f. of wing dams constructed, extended, and repaired, **98**, 1210.

**1899–1900.** 11,048 c. y. earth excavated, 1,409 c. y. cobbles, 4,349 c. y. soft rock, and 6,386 c. y. hard rock removed, **1900**, 1726. Dike built below Dutch Gap Cut-Off and 24 jetties repaired, **1900**, 1729, 1730.

**Physical characteristics.**

James River an estuary below Richmond Bar, **75**, ii, 78; **76**, 296.

Tides, **73**, 778, 779; **74**, ii, 42; **75**, ii, 75, 76, 78, 81, 82; **76**, 292, 293, 296: **77**, 288; **78**, 456; **79**, 518.

Tide gauge, registry of, **76**, 293; **77**, 288; **78**, 460.

Tides lowered by removal of obstructions, **75**, ii, 82; **76**, 292.

Bed of river, character of, **75**, ii, 80, 81.

Stable regimen produced by proper contraction of width, **75**, ii, 80; **76**, 298, 299; **77**, 284, 286, 287; **78**, 458; **79**, 515.

Low-water slope, **75**, ii, 78, 81; **76**, 296, 298, 301.

Comparison of, measured and calculated, **76**, 298.

High-water slope, **78**, 456.

High water and effects of, **75**, ii, 82; **76**, 293, 300; **77**, 286; **78**, 456; **79**, 517.

Discharge of river, **75**, ii, 79; **76**, 296.

Sediments transported by river, **76**, 300.

Tides at Richmond, **80**, 650; **81**, 896; **82**, 866, 879.

Cross-sectional areas of river bottom near Richmond, **82**, 866.

List of freshets and height of rise of each since 1847, **82**, 868.

Float observations, 1882, **82**, 868.

Report of survey showing conditions of river and proposed improvements in 1837, **82**, 888.

Cross sections, **85**, 955.

Comparative cross sections of river, **87**, 873.

Freshets in the James River, 1888–89, **89**, 941.

Comparison of freshet slopes, **89**, 941.

Table showing the available draft of water at high tide throughout the improved portions of the river, **90**, 997.

Widths and depths and range of areas, **93**, 1259, 1260; **94**, 922; **95**, 1191; **96**, 1014; **98**, 1216.

Tidal observations, **93**, 1255; **94**, 916; **95**, 1187; **96**, 1010, 1011; **98**, 1213, 1216.

Effect of works of direction, **94**, 921; **95**, 1190.

General description of, **98**, 1216; **99**, 1437.

**Plans.**

James River and Kanawha Canal, **71**, 624; **73**, 828; **74**, ii, 86.

**Private and corporate work.**

(See *Operations*.)

Up to 1875 city of Richmond had appropriated $250,000, to be expended under direction of common council in dredging on west bars, **70**, 68; **71**, 73, 598, 603; **75**, ii, 83; progress of work, in cooperation with U. S., in 1871–72, **72**, 69, 691; in 1872–73, **73**, 75, 774, 776. Transferment

## JAMES RIVER, VA.—Continued.

January 1, 1873, of dredging plant to U. S., at rental not exceeding cost of repairs, **73**, 777; **74**, ii, 41; arrangement canceled May 1, 1875, **75**, ii, 81; progress of dredging in 1875–76, **75**, 88. Transferment of part of dredging outfit to U. S. on previous basis, **76**, 291; cooperation of city with U. S., **76**, 292.

**1876–77.** Continued use by U. S. of dredging outfit and cooperation of city with U. S., **77**, 60, 284, 285. Necessity of city owning dredging outfit, **75**, ii, 84. Report of commission acting for city, **75**, ii, 83.

**1877–78.** Continued use by U. S. of dredging outfit belonging to city of Richmond and cooperation of city with U. S. in dredging operations, **78**, 65, 453, 455, 461.

**1878–79.** Continued cooperation of city of Richmond, **79**, 512, 515.

Assistance given by city of Richmond by money appropriated, work done, placing machinery at disposal of Government, **80**, 647; **81**, 891, 894; **83**, 685; **85**, 954.

Total expenditures by city of Richmond, $444,696.45, **86**, 138; **87**, 867.

**Projects.** (See *Estimates.*)

The original project of 1870, together with its modifications to 1882, proposed to secure between Richmond and the sea a channel 180 f. wide and 18 f. deep at full tide, or about 15 f. deep at m. l. w. It was to be secured by the removal of rock and bowlders, dredging on bars, and deposition of material behind rectifying dikes; excavation through Dutch Gap Cut-off and cut-offs near Jones Neck and Bermuda Hundred, **71**, 604; **72**, 691; **76**, 298; **79**, 516, 520; **86**, 138. Aggregate of the appropriations from 1870 to 1882, inclusive, $740,000.

By Col. Craighill, 1882, increasing previous widths and depths of channel so as to secure 25 f. at full tide, or 22 f. at half tide, between Richmond and the sea. The width of channels to be as follows: From mouth to City Point, 400 f.; from thence to Drewry Bluff, 300 f., and from thence to the city of Richmond, 200 f.; estimate, $4,500,000, **82**, 871, 876; **85**, 947; **86**, 138; **87**, 867; **91**, 1234.

Lt. Col. Allen estimated, 1899, it would cost $724,943.15 to continue improvement, and if a turning area be included an additional cost of from $150,000 to $200,000, **1900**, 1758, 1759.

**Surveys.**

Detailed survey made, 1852, **70**, 68; **71**, 603.

Examination shows but slight changes since, 1870, **70**, 68; **71**, 603.

In progress, connecting James River with Kanawha Canal, 1870–73, **70**, 69; **71**, 76, 624; **72**, 74; **73**, 78, 828.

From ship lock (Richmond) to below Trents Reach, 1874, **74**, 86, ii, 39; **75**, ii, 74. Details and methods used, **75**, ii, 74; **76**, 295; bench-marks, **75**, ii, 78; gauging discharge, methods and discussion of, **75**, ii, 79; analysis of survey, **76**, 295.

Ordered by act of Mar. 3, 1881, made, 1881, under direction of Lt. Col. Craighill, **82**, 870, 878.

Comparison made in 1884 and 1887, **84**, 906; **87**, 873.

Miscellaneous surveys and examinations, **93**, 1255; **94**, 916; **95**, 1187; **96**, 1010; **97**, 1347; **99**, 1437.

Examination and survey, with a view to determine what expenditure would be necessary to continue improvement to the head of navigation at the docks, ordered by act of Mar. 3, 1899, made, 1899, under direction of Lt. Col. Allen. (Report favorable.) (See *Projects.*) (Maps, **1900**, 1736), **1900**, 1754, 1755, 1757.

Maps and sections at Dutch Gap Canal and Rockett's Reef, Richmond Bar, etc., **76**, 294, 298; **77**, 286. Map of Dutch Gap Cut-off, **79**, 520; **1900**, 1736.

## JAMESTOWN ISLAND, JAMES RIVER, VA.

**Appropriations.**

1894, $10,000, **95**, 1192.
1896, 15,000, **96**, 1016.

Total, 25,000

**Contracts.**

**1895.** Eggleston & Montague, excavation, 25 cents per c. y.; paving, $3.50 per c. y.; rough stone, $1.03 per t.; piles in groins, 25 cents per l. f.; capping, 24 cents per l. f.; turfing, 15 cents per s. y.; brush mats, 5 cents per c. f. ($14,808.50), **95**, 1193.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 156; **96**, 140; **97**, 189; **98**, 191; **99**, 222; **1900**, 253.

ENGINEERS IN CHARGE:

Lt. Col. P. C. Hains, 1895–96. Reports, **95**, 1192; (Col.), **96**, 1016.

Lt. Col. C. J. Allen, 1897–. Reports, **97**, 1349; **98**, 1219; **99**, 1440; **1900**, 1736.

**Operations.**

**1894–95.** A wall of granite was built along the threatened portion of the island, **95**, 1192.

## JAMESTOWN ISLAND, JAMES RIVER, VA.—Continued.

**Projects.**

Congress, 1894, made an appropriation for protecting the island from the encroachments of the James River, **95**, 1192.

By Lt. Col. Hains, 1894–95, building a wall faced with granite in front of the island and for grading and turfing the bluff behind it, and for adding several groins in front of the wall, **95**, 1192.

By Lt. Col. Allen, 1896–97, regrading the bank and levee where necessary and covering it with a slope wall of stone laid in hydraulic mortar, protected by riprap and concrete blocks so far as funds would admit, **97**, 1350; revised, 1900, to provide for a revetment of concrete blocks or flagstones, with macadam backing 1 f. thick, laid against the graded bank of the island, the toe of the slope to rest against a strong low line of sheet piling, to be protected against wave action, if necessary, by stone riprap, **1900**, 1737, 1738.

**Surveys.**

Examination made, 1896–97, by Lt. Col. Allen, **97**, 1349.

## JEFFERSON, TEX. (See *Cypress Bayou.*)

## JEFFERSONVILLE, IND. (See *Ohio River.*)

## JEKYL CREEK, GA. (See *Savannah, Ga.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $5,000, | **89**, | 1272. |
| 1890, | 7,500, | **90**, | 1422. |
| 1892, | 7,500, | **92**, | 1286. |
| 1894, | 4,000, | **95**, | 1507. |
| Total, | 24,000 | | |

**Commerce.**

Description of, **93**, 1591.

In 1893 the annual traffic was estimated to be worth about $1,000,000, **93**, 1591; in 1894, $900,000, **95**, 1506.

**Contracts.**

**1888.** P. S. Ross, dredging, 20 cents per c. y., **89**, 1272.

**1891.** J. F. Gaynor, training-wall construction, $21,270. P. S. Ross, dredging, 24 cents per c. y. **91**, 1559.

**1893.** Atlantic Contracting Co., jetty construction; mattresses, 99 cents per s. y.; riprap stone, $3.59 per c. y., ($19,680), **93**, 1593.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 1162; **87**, 154; **88**, 142, 143; **89**, 163; **90**, 146; **91**, 183; **92**, 179; **93**, 197; **94**, 181; **95**, 205; **96**, 184.

ENGINEER IN CHARGE:

Lt. Col. Q. A. Gillmore, 1880–89. Reports, **81**, 1162; (Col.), **88**, 1073, 1075.

Capt. O. M. Carter, 1889–96. Reports, **89**, 1270; **90**, 1420, **91**, 1556; **92**, 1283; **93**, 1590; **94**, 1197; **95**, 1504, **96**, 1283.

ASSISTANT. Lt. O. M. Carter. Report, **88**, 1076.

**Operations.**

**1888–89.** 20,486 c. y. dredged, **89**, 1271.

**1890–91.** Training-wall construction begun, **91**, 1557.

**1891–92.** 13,000 c. y. dredged, **92**, 1284.

**1892–93.** 17,170 s. y. mattresses and 1,252 c. y. riprap stone placed, **93**, 1591.

**1894–95.** 29,844 c. y. dredged, 10,616 s. y. mattresses and 1,873 c. y. riprap stone placed, **95**, 1506.

**Physical characteristics.**

Description of, **81**, 1162; **88**, 1075; **93**, 1590.

**Plans.**

By Lt. Col. Gillmore, 1880, for improvement of the creek from its mouth to the deep waters of Brunswick River by training-wall and closure-dam construction and dredging. Estimate, $25,323, **81**, 1164.

**Projects.**

By Col. Gillmore, 1888, establishment and maintenance of a 7-f. low-water channel through the shoals in the creek by the construction of training wall at its mouth, the erection of a dam to close Mud River, and dredging; the dredged channels to have a bottom width of 50 f.; estimate, $38,590, **90**, 1421.

**Surveys.**

Examination ordered by act of June 14, 1880, made, 1880, under direction of Lt. Col. Gillmore, **81**, 1162.

Examination ordered by act of Aug. 5, 1886, **87**, 154.

Survey ordered by act of Aug. 5, 1886, made, 1887, under direction of Col. Gillmore, **88**, 1073, 1075.

Examination made by Capt. Carter, 1894, **94**, 1199.

MAPS.

**88**, 1076; **89**, 1272; **92**, Atlas, 59; **93**, 1592.

**JERSEY CITY.** (See *Hudson River.*)

**JERSEY CITY TO ELLIS ISLAND (Ship Channel), N. Y.**

**Commerce.**
Important. **89**, 804.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 83.
ENGINEER IN CHARGE. Lt. Col. G. L. Gillespie, 1888. Report, **89**, 801.

**Plans.**
By Lt. Col. Gillespie, 1889, excavating ship channel 2,375 feet long between Jersey City and Ellis Island, with a depth of 26 f. at m. l. w. and a width of 300 f.; estimated cost, $108,462; also basin with a depth of 26 f. and an area of about 70 acres for anchorage purposes; estimated cost, $442,340, **89**, 803.

**Survey.**
Ordered by act of Aug. 11, 1888; made, 1889, under direction of Lt. Col. Gillespie, **89**, 801.
MAPS. **89**, 802.

**JOAQUIN, TULARE, AND SACRAMENTO VALLEYS, CAL. (Irrigation of.)**

**Commerce.**
STATISTICS, H. Doc. 290, 43d Cong., 1st sess., p. 89.

**Engineers.**
CHIEF OF ENGINEERS. Report, **74**, 126.
BOARD OF ENGINEERS. Commission of 1873. (See *Plans.*) H. Doc. 290, 43d Cong., 1st sess., **74**, 126. (Lt. Col. Alexander, Maj. Mendell, and Prof. Davidson.)

**Estimates.** (See *Plans.*)
Estimated cost of irrigation, about $10 per acre, H. Doc. 290, 43d Cong., 1st sess., **73**, 77.

**Legislation.**
Concerning irrigation, H. Doc. 290, 43d Cong., 1st sess., p. 89.

**Physical characteristics.**
The necessity for irrigation in California, H. Doc. 290, 43d Cong., 1st sess., p. 7. Influence of irrigation on the navigation of rivers, H. Doc. 290, 43d Cong., 1st sess., p. 30.

**Plans.** (See *Estimates.*)
The commission favored a general system of irrigation, to be designed by the Government or by association of capital, the work to be under the supervision of the State. The Board considered extensive irrigating works could not be built by private enterprise alone, and recommended a careful instrumental survey before beginning the work, **74**, 126, 127. System of irrigation; what is irrigation? Existing and hypothetical canals; general considerations, H. Doc. 290, 43d Cong., 1st sess., pp. 27, 34, 37, 38. History, description, and statistics of irrigation in foreign countries, H. Doc. 290, 43d Cong., 1st sess., p. 40.

**Surveys.**
Preliminary reconnoissance; necessity of survey, H. Doc. 290, 43d Cong., 1st sess., pp. 5, 26.
MAPS:
Map of valleys; rain charts of United States, H. Doc., 43d Cong., 1st sess., pp. 6, 92.
Sketch of system at the river Cavery, in the Madras Presidency.
Map of tank system in India, H. Doc. 290, 43d Cong., 1st sess.

**JOHNSONS BAYOU, LA.**

**Appropriation.**
1899, $2,500, **99**, 1855.

**Commerce.**
Amounted to 3,163 t., 1899, **1900**, 2268.

**Contracts.**
**1899.** C. Clarke & Co., dredging, 19 cents per c. y. ($2,090), **1900**, 2269.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **99**, 332; **1900**, 377.
ENGINEERS IN CHARGE:
Maj. J. B. Quinn, 1897-99. Report, **99**, 1855.
Maj. H. M. Adams, 1900. Report, **1900**, 2268.

**Operations.**
**1899-1900.** 11,762 c. y. dredged, completing project, **1900**, 2268.

**Projects.**
By Maj. Quinn, 1899, 6-f. channel from the 6-f. depth in Sabine Lake to a 6-f. depth in the bayou, of such width as funds would permit, **99**, 1855.

**Survey.**
Preliminary examination made, 1897, in connection with a survey of Sabine Lake, by Maj. Quinn (report favorable), **97**, 1789; **99**, 1855.

## JOHNSTOWN, PA. (See *Kiskiminetas River.*)

## JONESPORT, ME. (See *Moosabec River at Jonesport, Me.*)

## JORDAN RIVER, MISS.

**Commerce.**

In 1893 the annual saving to commerce by an improvement of the river would probable be $5,000, **93**, 1789.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 238.

ENGINEER IN CHARGE. Maj. A. N. Damrell, 1892-93. Report, **93**, 1789.

**Physical Characteristics.**

Description of; the river has about 16 navigable miles, is 10 f. deep, and empties into the northeastern extremity of Bay St. Louis, and has a number of tributaries navigable for short distances, **93**, 1789.

**Surveys.**

Examination of the bar at the mouth of the river ordered by act of July 13, 1892, made by Maj. Damrell 1892, (report unfavorable), **93**, 1789.

## JOY LANDING, ILL. (See *Mississippi River at Rush Bend and Joy Landing.*)

## JUAN DE FUCA STRAIT, WASH. (See *Pacific Coast, harbor of refuge; Port Orford.*)

## JUNIATA TO THE POTOMAC RIVER (for canal).[a]

## JUPITER INLET, FLA. (See *Indian and St. Johns rivers, Fla.*)

## KALAMAZOO RIVER (HARBOR), MICH. (See *Saugatuck Harbor.*)

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $5,000, | **97**, 2915. |
| 1899, | 10,000, | **99**, 2913. |
| Total, | 15,000 | |

**Commerce.**

Description of, **95**, 2844.

Important only from Lake Michigan to Saugatuck, **95**, 2843.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **95**, 396; **96**, 356; **97**, 426; **98**, 414, 424; **99**, 491, 492; **1900**, 555, 556.

ENGINEERS IN CHARGE:

Lt. Col. G. J. Lydecker, 1895-96, 1898. Reports, **95**, 2841; **96**, 2739; **98**, 2506, 2537.

Capt. C. McD. Townsend, 1897. Report, **97**, 2915.

Capt. C. Harding, 1899-. Reports, **99**, 2910, 2912; **1900**, 3887, 3890.

ASSISTANTS:

B. H. Muehle. Report, **95**, 2843.

G. W. Bunker. Report, **98**, 2539.

**Physical characteristics.**

Description of, **95**, 2842; **96**, 2741; **98**, 2538.

Borings, **98**, 2540.

Gauge readings, **98**, 2544.

Discharge observations, **98**, 2542.

**Projects.**

In 1896 Lt. Col. Lydecker estimated that it would cost $172,645 or $146,300 to improve the river, **96**, 2742.

By Lt. Col. Lydecker, 1896, for making a new cut through to Lake Michigan to obtain an entrance channel with a depth of 12 f.; estimate, $150,000, **97**, 2915.

In 1897 Capt. Townsend estimated it would cost from $5,000 to $100,000 to improve the river from Saugatuck to New Richmond, by four different projects, **98**, 2537.

Capt. Harding, 1900, estimated it would cost at least $200,000, because of the rise in prices and labor, to complete the project of 1896, **1900**, 3890.

**Surveys.**

Examination of the river from its mouth to the city of Kalamazoo ordered by act of Aug. 17, 1894, made, 1894, by Lt. Col. Lydecker (report unfavorable, mouth to Saugatuck; favorable, above Saugatuck), **95**, 2841.

Survey of the river from Lake Michigan to Saugatuck, in compliance with resolution of Feb. 13, 1895, made by Lt. Col. Lydecker, 1896 (see *Projects*), **96**, 2739.

Survey of the river from Saugatuck to New Richmond ordered by act of June 3, 1896, made, 1897, by Capt. Townsend (see *Projects*), **98**, 2537.

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[a] Examination—Report (indefinite), Mar. 30, 1826. (H. Doc. No. 482, 55th Cong., 2d sess.)

**KANAWHA AND JAMES RIVER CANAL.** (See *James River and Kanawha Canal.*)

**KANAWHA CANAL.** (See *James River and Kanawha Canal; Roanoke and Kanawha Canal.*)

**KANAWHA RIVER.** (See *Great Kanawha River, W. Va.; Little Kanawha River, W. Va.; Ohio River; Transportation Routes to the Seaboard.*)

**KANKAKEE RIVER, ILL. AND IND.**

**Commerce.**
Small, **85**, 1646.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 109; **79**, 148, 149; **80**, 199; **84**, 269; **85**, 257.
ENGINEERS IN CHARGE:
Maj. J. A. Smith, 1879–84. Reports, **79**, 1455; **80**, 1844; **84**, 1766.
Capt. J. C. Post, 1884–85. Report, **85**, 1645.
ASSISTANTS:
J. Worrall, C. E., **79**, 1455.
A. L. Duvall. Report, **85**, 1647.

**Physical characteristics.**
Reclamation of lands, **79**, 1457.
Description of Rock forming bed of river, **84**, 1766.
Description of, **79**, 1456–1460; **84**, 1767; **85**, 1647.

**Plans.**
By J. Worrall, 1867, slack-water navigation, mouth to Momence, 47.5 miles; locks 100 f. by 17 f. by 5 f.; estimate, $950,000, **79**, 1456.
By Maj. Smith, 1879, in Indiana, widening, deepening, and straightening for about 150 miles; estimate, $150,000, **79**, 1458.
By Maj. Smith, 1880, mouth to Momence, slack-water navigation, three masonry locks, lift of 12 f., 63,000 l. f. canal, construction and repair of dams, and removing reefs and similar obstructions; estimate, $550,000, **80**, 1844, 1846.
In 1882 Maj. Smith reported that the river could be improved only with slack-water system; not a public necessity, **84**, 1767, 1768.
In 1884 Capt. Post reported the river unworthy of improvement, **85**, 1647.

**Private (corporate and State) work.**
**1847.** Kankakee Co. connected the Illinois and Michigan canals and completed 21 miles of slack-water navigation, **79**, 1455, 1456.
Canal-feeder and dam constructed by State of Illinois, **79**, 1455.

**Surveys.**
By J. Worrall, 1867, **68**, 459, 466, etc.; **79**, 1455.
Examination completed by Maj. Smith, **78**, 109; **79**, 148, 1455.
Survey by Maj. Smith, **79**, 149.
Ordered by act of Mar. 3, 1879, made, 1879, under direction of Maj. Smith, **80**, 1844.
Examination ordered by acts of Aug. 2, 1882, and July 5, 1884 (see *Plans*), **84**, 1766; **85**, 1645.

**KANSAS CITY, MO.** (See *Missouri River between mouth and Sioux City.*)

**KANSAS RIVER, KANS.**

**Commerce.**
Description of, unimportant, **79**, 1092, 1093; **93**, 2295.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 93; **79**, 127; **93**, 294.
ENGINEER IN CHARGE. Maj. C. R. Suter, 1879–93. Reports, **79**, 1089; (Lt. col.), **93**, 2293.
ASSISTANT. J. D. McKown. Report, **79**, 1089.

**Legislation.**
Kansas legislature declared stream unnavigable in 1864, and authorized construction of bridges over it, etc. Law not sustained by U. S. courts, **93**, 2294.

**Obstructions.** (See *Physical characteristics.*)
Milldam and a number of low bridges obstructing line of navigation, **93**, 2294.

**Physical characteristics.**
Description, **79**, 1089–1091.
Obstructions, artificial and natural, **79**, 1089–1091.
Discharge, **79**, 1092.
Description of. The Kansas, or Kaw, River formed by junction of Republican and Smoke Hill rivers, about 176 miles long, enters the Missouri, and is entirely within Kansas. Numerous obstructions of all kinds hinder or prevent navigation, **93**, 2293.

## KANSAS RIVER, KANS.—Continued.

**Plans.**

By J. D. McKown, 1879, mouth to Topeka, l. w. depth of 4½ f.; Topeka to Junction City, l. w. depth of 3½ f. with wing dams and by removal of obstructions; estimate, $450,000, **79**, 1092. Recommendation reserved by Maj. Suter until determined by a detailed survey, **79**, 1089.

**Surveys.**

Examination from mouth to Junction City, Kans., ordered, **78**, 93. Completed in 1879 by J. D. McKown, **79**, 127,1089.

Examination ordered by act of July 13, 1892; report submitted, 1893, by Lt. Col. Suter, president Missouri River Commission (report unfavorable), **93**, 2293.

**KARQUINES STRAIT, CAL.** (See *San Diego Harbor and River; San Francisco Harbor.*)

**KASKASKIA BEND.** (See *Mississippi River between Falls of St. Anthony and Cairo.*)

## KASKASKIA RIVER, ILL.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $6,000, | **91**, 2118. |
| 1892, | 4,500, | **92**, 1746. |
| Total, | 10,500 | |

**Commerce.**

Flour trade; **88**, 1454.

**Engineers.**

Chief of Engineers. Reports, **88**, 195; **91**, 263; **92**, 252; **93**, 284; **94**, 260; **95**, 290; **96**, 252.

Engineers in Charge:

Maj. A. M. Miller, 1886–92. Reports, **88**, 1453; **91**, 2118; **92**, 1745.

Maj. C. J. Allen, 1893–95. Reports, **93**, 2185; **94**, 1624; **95**, 2093.

Maj. T. H. Handbury, 1896. Report, **96**, 1761.

Assistants:

C. D. Lamb. Report, **88**, 1456.

R. Klemm. Report, **92**, 1746.

**Obstructions.**

Bridges crossing the Kaskaskia, **88**, 1455.

**Operations.**

**1891–92.** Construction of quarters and preparation of plant; 31,838 c. f. of stone dike built at Evansville Shoal; rock removal at Kaskaskia and Nine Mile Shoal, **92**, 1746.

**1893–94.** Some snags, etc., removed; 170 c. y. rock removed from channel; dikes at Evansville repaired, **94**, 1625.

**Physical charcteristics.**

Description of, **88**, 1453.

**Projects.**

By Maj. Miller, 1888, New Athens to mouth, l. w. depth of 3 f. at a Mississippi stage of 6½ f., by removal of two rock-and-gravel shoals; estimate, $6,000, **88**, 1455, 1456. Increased to $10,500 in 1892, **92**, 1746; **95**, 290, 2093, 2094.

**Surveys.**

Survey ordered by act of Aug. 5, 1886, made, 1888, under direction of Maj. Miller, **88**, 1455.

**KAUKAUNA, WIS.** (See *Fox River.*)

## KAWKAWLIN RIVER, MICH.

**Commerce.**

Description of, unimportant, **95**, 2846.

**Engineers.**

Chief of Engineers. Report, **95**, 396.

Engineers in Charge. Lt. Col. G. J. Lydecker, 1894–95. Report, **95**, 2846.

Assistant. B. H. Muehle. Report, **95**, 2847.

**Physical characteristics.**

Description of; a small stream flowing into Saginaw Bay about 2 miles west of the mouth of Saginaw River, **95**, 2847.

**Surveys.**

Examination ordered by act of Aug. 17, 1894, made, 1894, under the direction of Lt. Col. Lydecker (report unfavorable), **95**, 2846.

**KEGOTANK BAY, DEL.** (See *Franklin City, Va.*)

**KELLEY BAYOU.** (See *Red River, Ark.*)

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[a] Survey.—Report Feb. 14, 1838; estimate, $70,720. (H. Doc. No. 482, 55th Cong., 2d sess.)

## KENNEBEC RIVER, ME.[a] (See *Richmond Harbor; Bath; Sasanoa River, Me.*)

**Appropriations.**

| | | |
|---|---|---|
| 1827, | $4,000.00 | **66**, iii, 28. |
| 1828, | 3,500.00 | |
| 1830, | 5,000.00 | |
| 1832, | 20.32, | act, July 3. |
| 1840, | 1,075.39, | act, July 20. |
| 1852, | 6,000.00, | act, Aug. 30. |
| 1866, | 20,000.00, | **67**, 490. |
| 1867, | 30,000.00, | **67**, 490. |
| 1869, | 14,850.00 | (allotted), act, Apr. 10. |
| 1870, | 15,000.00, | **70**, 81. |
| 1871, | 15,000.00, | **71**, 90. |
| 1872, | 8,000.00, | **72**, 89. |
| 1873, | 12,000.00, | **73**, 98, 1064. |
| 1874, | 12,000.00, | **74**, 108. |
| 1875, | 15,000.00, | **75**, 115. |
| 1888, | 75,000.00, | **89**, 528. |
| 1890, | 50,000.00, | **90**, 443. |
| 1892, | 100,000.00, | **92**, 514. |
| 1894, | 50,000.00, | **95**, 559. |
| 1896, | 55,000.00, | **96**, 564. |
| Total, | 491,445.71. | |

**Commerce.**

Important, **67**, 491, 495, 496; **69**, 456, 457.

Increase of, **68**, 858,

Importance of the river as a water communication between the seaboard and the interior of the State; lumber, granite, and ice shipments, **88**, 415, 416.

Shipping and freight, **89**, 529.

Description of, **1900**, 1124.

**Contracts.**

**1867.** A. R. Wright, dredging, 40 cents per c. y., **67**, 490, 492.

**1868.** A. R. Wright, dredging, 40 cents per c. y., **68**, 852, 854.

**1871.** A. R. Wright, dredging, 40 and 50 cents per c. y., **71**, 843, 844.

**1872.** G. W. Townsend, removing rock, $30 per c. y., **72**, 931. A. R. Wright, dredging, 50 cents per c. y., **72**, 931; **73**, 1063.

**1873.** E. M. Le Prohon, removal of rock, **73**, 1064.

**1874.** E. M. Le Prohon & Co., removal of rock, $33.50 per c. y.; I. Hamilton, removal of rock, $15 per c. y., **75**, ii, 392.

**1889.** M. J. Wheeler, stone, 99 cents per t.,, and fascines, 85 cents each, **89**, 528.

**1890.** Jordan & Carleton, removal of old bridge piers, $2,423, **91**, 593.

**1892.** Moore & Wright, dredging, 17½ cents per c. y., **92**, 515; 28 and 40 cents per c. y., s. m. ($42,600), **93**, 698.

**1893.** Townsend & Olsen, ledge removal, $12.47 per c. y., p. m. ($23,518.42), **93**, 698.

**1895.** Moore & Wright, dredging, 24 and 29 cents per c. y., s. m. ($40,070), **95**, 560. Rogers & Fitzpatrick, ledge removal, $9.87 per c. y., p. m. ($14,814.87), **95**, 560.

**1898.** Moore & Wright, dredging, 40 cents per c. y., s. m., and bowlder removal, $10 per t. ($18,000), **98**, 829.

**Defense.**

U. S. arsenal at Augusta, **67**, 496.

Importance of improvement to the U. S. in case of war, **67**, 490, 496.

Fort Popham, at the mouth of the Kennebec, **67**, 490, 495.

**Documents.** (Not published in reports.)

H. Doc. 91, 39th Cong., 2d sess. Survey of Kennebec and Penobscot rivers, **67**, 17.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7, ii, 40, iii, 28; **67**, 17, 49; **68**, 71; **69**, 62; **70**, 80; **71**, 89; **72**, 89; **73**, 97; **74**, 107; **75**, 115; **76**, 40; **77**, 34; **78**, 38; **88**, 16, 22; **89**, 25; **90**, 20; **91**, 26, 33, 424; **92**, 30, 39; **93**, 28; **94**, 28; **95**, 30; **96**, 33; **97**, 35; **98**, 45; **99**, 53; **1900**, 58, 64.

ENGINEERS IN CHARGE.

Col. S. H. Long, 1837; **67**, 494.

Col. J. D. Graham, 1864–66. Report, **66**, 36.

Maj. B. S. Alexander, 1866; **66**, ii, 40; **67**, 493.

Lt. Col. George Thom, 1866–78. Reports, **67**, 488, 490, 492; **68**, 852, 856; **69**, 455; **70**, 500, 506; **71**, 842; **72**, 930; **73**, 1063; **74**, ii, 303; **75**, ii, 392; **76**, 158; **77**, 162; **78**, 195.

Lt. Col. J. A. Smith, 1888–92. Reports, **88**, 412, 417; **89**, 527; **90**, 442; **91**, 590, 622.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 513, 544; **93**, 693; **94**, 508.

Lt. Col. D. P. Heap, 1895. Report, **95**, 557.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 560.

Maj. R. L. Hoxie, 1897–98. Reports, **97**, 787; **98**, 828.

Maj. S. W. Roessler, 1899–. Reports, **99**, 1039; **1900**, 1095, 1121, 1127.

ASSISTANT.

F. S. Burrowes. Reports, **88**, 421; **92**, 547; **1900**, 1129.

A. C. Both. Reports, **1900**, 1125.

**Estimates.** (See *Plans* and *Projects.*)

By Lt. Col. Thom, dredging through Shepards Point Shoal, $10,214.32, **67**, 494. Increased depth, $17,503.50, **67**, 494. Dredging channel through all the shoals, $50,000, **67**, 490. To excavate a

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[a] At Lovejoys Narrows: Examination—Report (favorable) Jan. 11, 1827. Bath to Augusta, Augusta to Skowhegan, mouth to Bath: Survey—Report Sept. 20, 1837; estimate $22,000. (H. Doc. 55th Cong., 2d sess.)

## KENNEBEC RIVER, ME.—Continued.

channel through Hinkleys and Browns Island Shoals, $3,000, **67**, 489. Modified estimate for completion of work from Gardiner to Augusta, $80,000, **68**, 852, 857.

By Lt. Col. Thom, Richmond to Gardiner, $12,976.30, **71**, 844. Removal of two ledges of rock below Richmond, $13,500, **72**, 932. Removal of Half-tide Rock and Ledge No. 2, etc., $30,603.60, **73**, 1064. Removal of ledges 3, 4, and 5, and Dry Rock, $40,500, **74**, ii, 303.

**Operations.**

**1867.** 63,526 c. y. dredged, **68**, 852.

**1869-70.** 30 bowlders removed and 22,039 c. y. dredged, **69**, 455; 50 bowlders removed and 39,672 c. y. dredged, **70**, 500.

**1870-71.** 50 bowlders removed and 12,510 c. y. dredged, **70**, 506; **71**, 842; **72**, 88, 931.

**1871-72.** 50 bowlders removed; Nehumkeg Rock removed and 28,466 c. y. dredged, **72**, 931.

**1872-73.** 7,795 c. y. dredged, **73**, 1064.

**1873-74.** Removal of Half-tide Rock, **74**, ii, 303.

**1874-75.** Removal of 3 ledges rock, **75**, ii, 392.

**1875-76.** 325 c. y. rock removed; work unsatisfactory, **76**, 40, 158.

**1876-77.** 805 c. y. rock removed, **77**, 35, 162.

**1877-78.** 545 c. y. rock removed, **78**, 38.

**1888-89.** 4,542 t. stone and 359 fascines delivered, **89**, 528.

**1889-90.** 24,735 t. stone and 6,600 fascines placed in the work, **90**, 442.

**1890-91.** 17,800 t. stone and 4,300 fascines placed in the work; 64,696 c. y. dredged; removal of old bridge piers begun, **91**, 591, 592, 593.

**1891-92.** 30,000 c. y. sand dredged, **92**, 513.

**1892-93.** About 12,000 t. stone placed in jetty at Upper Sands Bar and about 9,000 t. stone placed in jetty at Beef Rock Shoal; dredging in progress, **93**, 696.

**1893-94.** About 90,000 c. y. dredged and 6,044 t. placed in jetty at Beef Shoal; over 600 c. y. ledge rock removed at Lovejoy Narrows, **94**, 511.

**1894-95.** Ledge removal completed; dredging in progress, **95**, 559.

**1895-96.** About 30,000 c. y. dredged and about 3,000 c. y. rock excavated; jetty at Beef Rock Shoal repaired with 2,660 t. stone, **96**, 563.

**1896-97.** In connection with preceding years, 133,715 c. y. dredged. About 1,383 c. y. rock excavated at Lovejoy Narrows, **97**, 787.

**1897-98.** Dredging in progress at Gages Shoal, **98**, 828.

**1898-99.** 37,409 c. y. dredged; 139 t. bowlders removed from Gages Shoal. Project completed, **99**, 1039.

**Physical characteristics.**

High and low water, **67**, 493.

Bed of river composed of sand and gravel, **67**, 493.

Rapid rise of river, **70**, 501.

Description of, **1900**, 1125, 1129.

**Plans.** (See *Projects.*)

By Col. Long, 1837, dredging channel through Shepards Point Shoal, **67**, 494.

By Lt. Col. Hains, 1892, 5-f. navigation, steamboat landing at Augusta to Waterville, at a cost of $45,800; also for lengthening the lock at Augusta, at a cost of $25,000; total estimate, $70,800, **92**, 547.

**Private (city) work.**

Dredging by Augusta, 1847, **67**, 494.

**Projects.** (See *Plans.*)

By Maj. Alexander, dredging a new channel through Shepards Point Shoal, **67**, 493.

By Lt. Col. Thom, new channel 75 f. wide at bottom and from 7 to 8 f. deep through all shoals; estimate, $50,000, **67**, 490. Approved by Chief of Engineers, **68**, 855. To increase width of channel to 100 f.; estimate, $80,000, **68**, 852, 857.

By Lt. Col. Thom, 1871, for: 1st, removal of Nehumkeg Rock; 2d, the removal of a ledge and bowlders below Gardiner; 3d, dredging Upper Sands Bar; 4th, dredging through Swan Island; 5th, removing ledge from channel near Richmond; estimate, $12,976, **71**, 843; **72**, 931.

By Lt. Col. Thom, removal of 2 ledges of rock below Richmond; estimate, $13,000, **72**, 932. Removal of Half-tide Rock, ledge No. 2, and sunken ledge; estimate, $30,603, **73**, 1064. Removal of ledges 3, 4, and 5 and Dry Rock; estimate, $40,500, **74**, ii, 303; **76**, 158.

By Col. Thom, 1870 and 1878, channel not less than 90 f. wide, and from 11 to 12 f. deep at m. l. w. by the removal of rock, **70**, 81; **78**, 197; **79**, 253; **82**, 67; completed in 1883; expenditure, $45,500, **83**, 62.

By Lt. Col. Smith, 1888, Kennebec River at Bath, and Augusta to lower end of Perkins Island, removal of shoals at Beef Rock, Hatchs Rock, and South Gardiner, and building of wing dams and training walls; removal of rocks in harbor at Bath and at Lovejoys Narrows, and dredging the shoals, Augusta to Gardiner;

### KENNEBEC RIVER, ME.—Continued.

estimate, $410,500, **88**, 417; **89**, 527. Increased in 1892 to $428,500, **92**, 514.

Project revised, 1892, to provide for a channel 13 f. deep to Sands Island, 12 f. thence to Hinckleys Shoal, and 10 f. thence to Augusta; a steamboat channel, 9 f. deep, west of Swan Island, and the removal of old bridge piers at Hallowell, to be accomplished by dredging, contraction works, and excavation; estimate, $388,500, **93**, 695.

By Maj. Roessler, 1899, a channel 125 f. wide and 16 f. deep at m. l. w. between Gardiner Bridge and Augusta dam; estimate, $81,000, **1900**, 1128.

**Surveys.**

Ordered, **67**, 17.

Under direction of Lt. Col. Thom, Hallowell to Augusta, **67**, 488, 494. Report, **68**, 851.

Narrows below Richmond, **72**, 932; **73**, 1064.

Ordered by act of Aug. 5, 1886, made, 1888, under direction of Lt. Col. Smith, **88**, 412, 417.

Survey ordered by act of Sept. 19, 1890, made, 1892, under direction of Lt. Col. Hains, **92**, 545.

Examination and survey ordered by act of Mar. 3, 1899, made under direction of Maj. Roessler, 1899 (report favorable), **1900**, 1122.

MAPS. **90**, 442.

## KENNEBUNK RIVER, ME.

**Appropriations.**

| | | |
|---|---|---|
| 1829, | $5,000, | act Mar. 2. |
| 1831, | 1,175, | act Mar. 2. |
| 1832, | 1,700, | act July 3. |
| 1834, | 10,300, | act June 28. |
| 1836, | 7,500, | act July 2. |
| 1837, | 3,000, | act Mar. 3. |
| 1838, | 8,000, | act July 7. |
| 1852, | 7,500, | act Aug. 30. |
| 1870, | 5,000, | **70**, 82, 506. |
| 1871, | 5,000, | **71**, 91. |
| 1876, | 5,000, | **76**, 41. |
| 1879, | 2,000, | **79**, 47. |
| 1880, | 2,000, | **80**, 339. |
| 1881, | 2,000, | **81**, 492. |
| 1890, | 20,000, | **90**, 449. |
| Total, | 85,175 | |

**Commerce.**

Important, **70**, 82, 506; **75**, ii, 433.

Obstructions to commerce, **75**, ii, 433.

**Contracts.**

**1870.** A. Blaisdell & J. S. Bailey, extending east pier, **71**, 855.

**1871.** C. H. Bragdon, extending west pier, **71**, 855.

**1877.** G. C. Fobes & Co., dredging 6,450 c. y., 50 cents per c. y., **77**, 166.

**1892.** J. F. Curit, stone and timbers, $1.05, $1.50, and $1.90 per t., and 5 pieces of timber at $20 for the lot ($2,158), **93**, 713.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 7; **70**, 82; **71**, 91; **72**, 91; **73**, 100; **75**, 115, 121; **76**, 41; **77**, 35; **78**, 39; **79**, 47; **80**, 67; **81**, 69; **82**, 68; **83**, 63; **84**, 71; **85**, 58; **86**, 57; **87**, 19; **88**, 19; **89**, 28, 32; **90**, 23, 26; **91**, 29; **92**, 35; **93**, 33.

ENGINEERS IN CHARGE:

Col. J. D. Graham, 1865. Report, **66**, 37.

Lt. Col. G. Thom, 1870–83. Reports, **70**. 506; **71**, 854; **72**, 937; **73**, 1077; **75**, 432; **76**, 161; **77**, 165; **78**, 202; **79**, 259; (Col.) **80**, 337; **81**, 491; **82**, 499.

Col. C. E. Blunt, 1883–86. Reports, **83**, 422; **84**, 468; **85**, 470.

Maj. J. A. Smith, 1886–92. Reports, **86**, 543; **87**, 461; (Lt. Col.) **88**, 392; **89**, 537; **90**, 449, 471; **91**, 601.

Lt. Col. P. C. Hains, 1892–93. Reports, **92**, 524; **93**, 712.

ASSISTANT. S. Haagensen. Report, **75**, ii, 433.

**Operations.**

**1853.** 600 l. f. eastern pier extended; 200 l. f. western pier extended; 160 l. f. eastern sand-catch built; 160 l. f. western sand-catch built; 300 l. f. crib wharf built, **76**, 161; **78**, 202.

**1870–71.** 168 l. f. eastern pier extended; repairs, **71**, 855.

**1871–72.** 166½ l. f. western pier extended; repairs, **72**, 91, 938.

**1877–78.** 6,450 c. y. dredged; repairs, **78**, 40.

**1880–81.** Ledges below Ward's wharf and at mouth of Gooch Creek removed to 4 f. depth; channel straightened and widened by dredging below Lord's and Ward's wharves and at upper part of Mitchell's Point; repairs to Government wharf, **81**, 492.

**1881–82.** Repairs to stone piers and Government wharf, **81**, 500.

**1883–84.** Repairs to Government wharf, **84**, 468.

**1887–88.** Repairs to wooden pier; project completed and no further work contemplated, **88**, 392.

**1890–91.** Repairs to wharf and piers in progress, **91**, 601.

**1891–92.** Repairs to wharf and protection of base of east jetty; construction of jetty at Wading Place, **92**, 525.

**1892–93.** Project completed, **93**, 713.

**Physical characteristics.**

Of channel, **75**, ii, 433.

## KENNEBUNK RIVER, ME.—Continued.

**Projects.**

By Lt. Col. Thom, two stone piers as wings to those already built; estimate, $10,000, **70**, 506; **71**, 854. Dredging at Mitchell's Point and the Wading Place; estimate, $5,000, **75**, ii, 434. Dredging, rock excavation, and repairs, to cost $6,000, **78**, 203; **79**, 260.

By Col. Thom, 1878, dredging, rock excavation, and repairs to piers and wharves; estimate, $6,000, **78**, 203; **79**, 260. Project completed in 1882, **82**, 500; **87**, 19.

After a survey in 1889, Lt. Col. Smith estimated $20,000 as the amount necessary to repair the piers and construct one small jetty, **90**, 449, 474.

**Surveys.**

By S. Haagensen, 1874. Report, **75**, ii, 433.

Under the direction of Lt. Col. Thom, **78**, 203.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Lt. Col. Smith, **90**, 449, 473.

## KENOSHA (Southport) HARBOR, WIS.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1844, | $12,500.00, | **66**, iii, 35. |
| 1845, | 15,000.00, | |
| 1852, | 10,000.00, | |
| 1866, | 75,461.41, | |
| 1869, | 5,346.00 (allotted), | **69**, 27. |
| 1870, | 10,000.00, | **70**, 36. |
| 1871, | 10,000.00, | **71**, 35. |
| 1872, | 10,000.00, | **72**, 33. |
| 1874, | 10,000.00, | **74**, 40. |
| 1875, | 15,000.00, | **75**, 45, 164. |
| 1876, | 8,000.00, | **76**, 98, 142. |
| 1878, | 8,000.00, | **78**, 117. |
| 1879, | 5,000.00, | **79**, 156. |
| 1880, | 5,000.00, | **80**, 1940. |
| 1881, | 5,000.00, | **81**, 2129. |
| 1882, | 6,000.00, | **82**, 2161. |
| 1884, | 5,000.00, | **84**, 1870. |
| 1886, | 5,000.00, | **86**, 1684. |
| 1888, | 7,500.00, | **88**, 1866. |
| 1890, | 17,500.00, | **90**, 2361. |
| 1892, | 15,000.00, | **92**, 2208. |
| 1894, | 15,000.00, | **95**, 2651. |
| 1896, | 24,000.00, | **96**, 2518. |
| 1899, | 50,000.00, | **99**, 2782. |
| 1900, | 135,000.00, | **1900**, 3707. |
| Total, | 484,307.41 | |

**Commerce.**

Importance as a harbor of refuge, **76**, ii, 393.

Important, **68**, 109; **76**, ii, 396; **79**, 1531.

Commercial importance of Kenosha, **67**, 83; **72**, 128; **73**, 212.

Railroad interests, **73**, 212; **76**, ii, 396.

The harbor No. 13 in the list of harbors along the western shore of Lake Michigan in commerce, **97**, 2784.

Description of, **1900**, 3768.

**Contracts.**

**1866.** Sanger, Ledlie & Corse, materials and labor, **66**, iv, 118; **67**, 58. Parker, Stebbins & Ackerman, dredging per c. y., 37 cents, **66**, iv, 118; **67**, 58, 85; **76**, ii, 394.

**1871.** R. A. Conolly, close piling and repairs, **71**, 116; **72**, 128.

**1872.** F. M. Knapp, materials and labor, **73**, 211; **76**, ii, 395.

**1874.** F. M. Knapp, materials and labor, **75**, 215; **79**, ii, 395.

**1875.** A. Conro, dredging per c. y., 20 cents, **75**, 215. Knapp & Gillen, materials and labor, **75**, 216.

**1878.** Chicago Dredging & Dock Company, for pier extension, **79**, 1530.

**1879.** Knapp & Gillen, pier extension, **80**, 1940.

**1881.** Knapp & Gillen, pier extension, **81**, 2129.

**1882.** Knapp & Gillen, removal and reconstruction of superstructure, **83**, 1709.

**1884.** G. H. Sager, reconstruction of superstructure, **85**, 2022.

**1886.** H. B. Herr & Co., superstructure reconstruction, **87**, 2072.

**1888.** C. H. Starke, dredging, 19 cents per c. y., **89**, 2081.

**1889.** S. O. Dixon, dredging, 17 cents per c. y., **90**, 2360.

**1890.** H. Cooper and G. Truman, pier extension, $9,812, **91**, 2567.

**1892.** Knapp & Gillen, 150 l. f. pier extension—timber, stone, etc.—$13,002, **93**, 2753. Actual cost, $94.78 per l. f. for north pier, including some superstructure; and $65.64 per l. f., for south pier, **49**, 2098.

**1894.** H. B. Herr & Co., 150 l. f. pier extension—timber, stone, etc.—$7,809, **95**, 2652. Actual cost, $68.30 per l. f. for north pier and $43.83 for south pier, **96**, 2517.

**1896.** Racine Dredge Co., dredging, 8¼ cents per c. y., $3,915, **97**, 2704. McArthur Bros. Co., 250 l. f. pier extension—timber, stone, etc.—$12,375.50, **97**, 2705. Actual cost, $49.53 per l. f., **98**, 2334.

**1899.** J. Cape & Sons, pile pier extension, $19,251.34. S. O. Dixon, removing and depositing stone, $15,000; moving

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[a] Surveys—Reports. Dec. 1, 1837, estimates, $90,703, $101,897.15; 1844, estimate, $50,592; July 18, 1854, estimate, $24,128.78; Sept. 30, 1857, estimate, $58,047.24 (H. Doc. No. 482, 55th Cong., 2d sess.).

**KENOSHA (Southport) HARBOR, WIS.**—Continued.

cribs, $7,000; dredging, 6.9 cents per c. y. ($24,840). R. B. Rice, breakwater and crib extension, $85,695.50. **99**, 2783.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, 5, iii, 11; **67**, 22; **68**, 31; **69**, 27; **70**, 36; **71**, 34; **72**, 33; **73**, 34; **74**, 40; **75**, 44; **76**, 97; **77**, 102; **78**, 117; **79**, 156. **80**, 208; **81**, 282; **82**, 277; **83**, 285; **84**, 286; **85**, 309; **86**, 303; **87**, 368; **88**, 244; **89**, 283, 286; **90**, 256; **91**, 326; **92**, 312; **93**, 355; **94**, 327; **95**, 365; **96**, 320; **97**, 404, 409; **98**, 396; **99**, 469, 473, 474; **1900**, 534, 539.

Report of Col. J. J. Abert, Corps of Topographical Engineers, 1854, **76**, ii, 394.

BOARD OF ENGINEERS. Report of a Board of Engineers in 1854, referred to. Difference of opinion between Board and Maj. Graham as to the dredging within river. **76**, ii, 394.

ENGINEERS IN CHARGE:

Maj. J. D. Graham, 1855–57. Report, S. Ex. Doc. No. 42, 35th Cong., 1st sess., page 61.

Maj. J. B. Wheeler, 1866–69. Reports, **66**, iv, 118; **67**, 83; **68**, 108.

Maj. D. C. Houston, 1870–84. Reports, **70**, 95; **71**, 116; **72**, 127; **73**, 211; **74**, 153; **75**, 214; **76**, ii, 393; **77**, 873; **78**, 1168; **79**, 1529; (Lt. Col.) **80**, 1938; **81**, 2128, **82**, 2161; **83**, 1708.

Capt. W. L. Marshall, 1884–89. Reports, **84**, 1869; **85**, 2021; **86**, 1684; **87**, 2072; **88**, 1866.

Maj. C. E. L. B. Davis, 1889–92. Reports, **89**, 2079, 2301; **90**, 2360; **91**, 2565.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2207; **93**, 2751; **94**, 2097.

Capt. C. F. Palfrey, 1895, Report, **95**, 2649.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2516; **97**, 2702, 2772; **98**, 2333.

Capt. J. G. Warren, 1899–. Reports, **99**, 2781, 2817; **1900**, 3706, 3767.

ASSISTANTS:

Capt. D. P. Heap. Reports, **67**, 83; **68**, 108.

W. H. Hearding, **72**, 127; **73**, 211; **74**, 153. Reports, **77**, 874; **78**, 1168; **79**, 1530; **80**, 1939; **81**, 2128; **82**, 2162; **83**, 1709; **84**, 1870; **85**, 2022; **87**, 2073.

**Estimates.** (See also *Plans* and *Projects*.)

By Board of Engineers, 1854, estimate of already-approved plans would cover expenditures under Maj. Graham's plans, **76**, ii, 394.

By Maj. Graham, 1857, additional for completion, $58,047.24, S. Ex. Doc. No. 42, 35th Cong., 1st sess., pages 61, 175, $75,461.41, **66**, 5.

By Maj. Wheeler, 1866, dredging in channel and extension of piers, $55,150.42, **66**, iv, 118, 119.

By Capt. Heap, 1867, pier extension, $47,905.74, **67**, 84.

By Maj. Wheeler, 1867, repairs and dredging, $55,000, **67**, 22, 23; **68**, 31; **69**, 27.

By Capt. Heap, 1868, repairs and pier extension, $70,000, **68**, 109.

By Maj. Houston, 1870, repairs to superstructure and dredging, $45,000; additional for extending each pier 224 f., $95,000, **70**, 96.

For dredging in 1873–74, $15,000, **72**, 128; **73**, 212.

Pier extension, repairs and dredging, $30,000, **74**, 155.

For completion of existing project, $80,000; this amount provided for probable pier extension for 20 years, but does not include any repairs which might be necessary in the meantime, **77**, 874. The original estimate probably the appropriation of 1866 increased by the estimate of 1868, viz, $145,461.41, **74**, 155. For completion of existing project $67,000, **79**, 156. For maintenance of harbor an annual sum of $8,000, **79**, 1530.

**Legal proceedings.**

Limits defined for lawful deposit of dredged or other material in Lake Michigan in vicinity of Kenosha approved by Secretary of War, 1899, **99**, 2781.

Land required under project of 1899 given to United States. Part of this land not needed proposed to be returned to original owners, **99**, 2782.

**Operations.**[a]

**1854–55.** Probable dredging in front of piers, and repairs of old work, **76**, ii, 394.

**1866–67.** South pier, 352 l. f. crib pier built; 40,050 c. y. dredged; north pier 970 f. long, south pier 800 f. long, **67**, 22, 86; **76**, ii, 394; **79**, 1529.

**1867–68.** North pier, 192 l. f. crib pier built; south pier, 352 l. f. superstructure built; 68,420 c. y. dredged, **68**, 31, 109; **76**, ii, 394.

**1868–69.** Displaced crib joined to main pier by pile work, **69**, 27, 28; **76**, ii, 394.

**1869–70.** End crib of north pier removed by storm, **70**, 36, 95; **76**, ii, 394, 395.

**1870–71.** North pier, 552 l. f. superstructure built; 552 l. f. old superstructure south pier replaced; repairs, **71**, 34, 35, 116; **76**, ii, 395.

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[a] **1867.** Crib lost after having been paid for, **74**, 155.

**1871.** One crib broken and lost, **74**, 155, **75**, 214. These accidents assumed to be due to the manner in which the cribs were bolted, **76**, ii, 395.

**72.** Length of channel between piers, 1,200 l. f.; width, 150 f.; average depth, 9½ f. below ke level, **72** 128. Abstracts of materials used and work done, **67**, 85, 86; **68**, 109; **72**, 128.

## KENOSHA (Southport) HARBOR, WIS.—Continued.

**1871–72.** North pier, 100 l. f. superstructure built; cribs refilled; displaced crib protected, **72**, 33, 128; **76**, ii, 395.

**1872–73.** North pier, 50 l. f. crib pier built; 412 l. f. superstructure built; 361 l. f. old superstructure north pier replaced, **73**, 34, 211; **76**, ii, 395.

**1873–74.** North pier, 50 l. f. superstructure built, **74**, 40, 153.

**1874–75.** North pier, 50 l. f. crib pier built; 430 l. f. superstructure built; 430 l. f. superstructure on north pier replaced, **75**, 44, 214.

**1875–76.** North pier, 50 l. f. crib pier built; channel dredged, **76**, 97, ii, 393.

**1876–77.** North pier, 100 l. f. superstructure built; repairs of piers, **77**, 102, 873.

**1877–78.** South pier, 9,919 c. y. dredged, **78**, 117, 1168.

**1878–79.** North pier, 100 l. f. crib pier built; total length of north pier, 1,450 f.; total length of south pier, 1,306 f., **79**, 156, 1530.

**1879–80.** Crib 50 by 24 by 16½ f. sunk upon stone foundation in extension of north pier; 100 l. f. superstructure built; 14-f. channel dredged between piers by city authorities, **80**, 1939.

**1881–82.** Crib 50 by 24 by 16½ f. sunk in extension of north pier; 26 cords riprap placed along north face of crib, **82**, 2162.

**1882–83.** Superstructure upon two cribs built up and latter decked over; north wall timbers built up 7½ f., **83**, 1709.

**1883–84.** Double row of sheet piling 170 f. in length, driven along south face of south pier; 20 cords of stone placed in cribs and around end of pier; repairs to south pier, **84**, 1870.

**1884–85.** 355 l. f. superstructure and outer section of south pier removed and rebuilt, **85**, 2022.

**1886–87.** 408 l. f. of south pier superstructure cut down and rebuilt under contract, **87**, 2072.

**1887–88.** 49 piles driven along channel face of inner section of south pier, and 7,272 c. y. sand dredged from the channel, **88**, 1866.

**1888–89.** 24,893 c. y. dredged, **90**, 2360.

**1889–90.** 5,248 c. y. dredged, **90**, 2360.

**1890–91.** 20,918 c. y. dredged; 3 cribs built in extension of south pier, **91**, 2566.

**1891–92.** Three cribs sunk, filled, and decked, extending the south pier 150 f.; 8,640 c. y. dredged, **92**, 2207.

**1892–93.** 10,197 c. y. dredged, and extension of piers in progress, **93**, 2752.

**1893–94.** 2,354 c. y. dredged, and in connection with preceding year north pier extended 100 f. and south pier 50 f., **94**, 2098.

**1894–95.** Pier extension in progress, **95**, 2650.

**1895–96.** In connection with preceding year, north pier extended 50 f. and south pier 150 f.; 10,751 c. y. dredged, **96**, 2516, 2517.

**1896–98.** 68,350 c. y. dredged, 2 wrecks removed, extension of south pier in progress, and channel face of south pier revetted, **97**, 2703; south pier extended 250 l. f., and minor repairs made to piers, **98**, 2333.

**1898–99.** Minor repairs; sheet piling of south pier in progress, **99**, 2781.

**1899–1900.** 200,779 c. y. dredged; 1,006 cords stone transferred, removing about two-thirds of old north pier; removal of 3 cribs in progress; breakwater under construction; about 925 l. f. pile pier built; part of south pier provided with sheet piling (photographs), **1900**, 3707.

**Physical characteristics.**

General, of Pike Creek, **76**, ii, 393.

Little or no current or scouring force in river, **72**, 128; **76**, ii, 393.

Character of lake bed unfavorable to the proper settlement of cribs, **73**, 211.

Advance of shore line, **76**, ii, 394; **77**, 874.

Description of, **97**, 2773; **99**, 2817; **1900**, 3768.

Shoaling, **93**, 2752; **94**, 2098; **95**, 2650; **96**, 2517; **97**, 2778.

Lake currents and their effects on lake harbors, **97**, 2775.

The harbor situated at the mouth of Pike Creek on the western shore of Lake Michigan, **97**, 2773.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Heap, 1867, on completion of the project of 1866, to further extend the piers 224 l. f. each, **67**, 83; **68**, 109.

**Private work.**

In 1852, **76**, ii, 394.

Dredging in channel in 1873–74, **74**, 154.

Docking, **77**, 875.

146 f. of south pier built by citizens, **79**, 1530.

**Projects.** (See *Estimates* and *Plans.*)

By Board of Engineers, **76**, ii, 394.

By Maj. Graham, 1857, extension of piers and sand barrier, with dredging in channel and basins to give required capacity for a harbor of refuge, S. Ex. Doc. No. 42, 35th Cong., 1st sess., p. 175.

By Maj. Wheeler, 1866, pier extension and dredging to 12 f., **66**, iv, 118; **67**, 83.

Dredging in channel, 1870, **72**, 128.

## KENOSHA (Southport) HARBOR, WIS.—Continued.

Pier extension and dredging to 16 f., **73**, 34, 212.

From 1844 to 1879, inclusive, $194,307.41 had been appropriated for pier extension, dredging, and repairs, **80**, 208.

By Maj. Houston, 1879, completion of Maj. Wheeler's project of 1866 for channel of 12 f. depth and navigable width by pier extension and dredging, $67,000, **79**, 156; **80**, 1938.

By Maj. Davis, 1889, extension of north pier 300 f. and south pier 600 f., to prevent the forming of a bar at the harbor entrance; estimate, $82,000, **89**, 2080; making the total estimate $149,000, **92**, 2206.

By Capt. Zinn, 1897, for extending south pier 525 f.; removing and rebuilding north pier from shore to shore to 21-f. contour, to obtain entrance width of 250 f., and increasing depth in channel and basin to 21 and 20 f. respectively, and widening channel between piers; estimate, $125,000, **97**, 2783.

By Capt. Warren, 1899, for 600-f. breakwater (6 cribs), 30 f. wide on a pile foundation; estimate, $66,000, **99**, 2818.

**Secretary of War.**

Plan of Board of Engineers, 1854–55, conditionally approved, **76**, ii, 394.

**Surveys.**

By Maj. Graham, 1855. See Map, **66**, No. 6.

Directed by Maj. Graham, 1857, S. Ex. Doc. No. 42, 35th Cong., 1st sess., p. 61.

Directed by Maj. Wheeler, 1867, **78**, 1529.

Directed by Maj. Houston and made by W. H. Hearding, **77**, 874. Soundings taken, 1878, **78**, 1168.

Examination for harbor of refuge ordered by act of August 11, 1888, made, 1888, under direction of Maj. Davis (report unfavorable), **89**, 2103.

Survey with a view to obtaining depth of 21 f. and a basin with a depth of 20 f. ordered by act of June 3, 1896, made, 1897, by Capt. Zinn (see *Projects*), **97**, 2772.

Survey to ascertain best plan to prevent injurious action of northeast seas ordered by joint resolution of January 10, 1899, made by Capt. Warren, 1899 (report favorable), (see *Projects*), **99**, 2817.

Examination for enlargement of basin ordered by act of March 3, 1899, made, 1899, by Capt. Warren (report recommended that nothing be done until completion of project), **1900**, 3768.

Maps: **66**, No. 6; **78**, 1168; **84**, 1870; **93**, 2752; **97**, 2784. (Photographs of works), **1900**, 3708.

## KENT ISLAND NARROWS, MD. (See *Chester River, Md.*)

## KENTUCKY RIVER AND ITS TRIBUTARIES, KY. (Including North Fork, Boone Fork, Middle Fork, Troublesome Creek, and South Fork.) (See *Rough River, Ky.*)

**Appropriations.**

| | | |
|---|---|---|
| 1879, | $100,000, | **79**, 146. |
| 1880, | 100,000, | **80**, 1827. |
| 1881, | 125,000, | **81**, 1976. |
| 1882, | 225,000, | **82**, 1949. |
| 1884, | 250,000, | **84**, 1725. |
| 1886, | 187,500, | **86**, 1606. |
| 1888, | 180,000, | **88**, 1771. |
| 1890, | 180,000, | **90**, 2263. |
| 1892, | 150,000, | **92**, 2085. |
| 1894, | 125,000, | **95**, 2485. |
| 1896, | 50,000, | **96**, 2288. |
| 1896, | 83,000, | **97**, 2514. |
| 1897, | 200,000, | **97**, 2514. |
| 1898, | 350,000, | **98**, 2016. |
| 1900, | 75,000, | **1900**, 3365. |
| Total, | 2,380,500 | |

**Commerce.**

Description of, **79**, 1400, 1401, 1403, 1405, 1406; **98**, 2016.

Mineral and timber resources tributary to river, **79**, 1401–1405.

At 1896 the value of the commerce of the entire river during the preceding seventeen years was estimated at $47,999,578, **96**, 2288.

Before the reopening of the stream by the United States freight rates on the railroads of the vicinity were so high as to almost prohibit shipments, **96**, 2288.

Description of actual and probable coal business, **98**, 2015.

**Contracts.**

**1882.** Stratham & Price, iron work, **82**, 1949.

**1884.** M. Williams, materials and labor for abutment construction, **85**, 1873. H. C. Jones, timber for guard-crib repair, **85**, 1873. Kirk & Abraham, materials, **85**, 1874. T. J. Hardin, timber, **85**, 1874. W. L. Pence, timber, **85**, 1874. I. V. Hoag, jr., materials and labor, **85**, 1875.

**1885.** Lomas Forge & Bridge Works, cast and wrought iron work, **85**, 1875. J. J. Cox, material and labor, **85**, 1876. Lomas Forge & Bridge Works, materials and labor, **86**, 1606.

**1886.** T. J. Hardin & Co., timber and piles, **86**, 1607. T. J. Congleton & Bro., lumber, **86**, 1607. T. Morris, cast and wrought iron, **86**, 1608. T. H. Carruthers, wrought-iron spikes, **86**, 1608.

**KENTUCKY RIVER AND ITS TRIBUTARIES, KY. (Including North Fork, Boone Fork, Middle Fork, Troublesome Creek, and South Fork.)**—Continued.

Scully & Peter, riprap stone, **86**, 1609. E. M. Pryse & Bro., coal, 6 cents per bushel, **86**, 1609. G. W. Gourley, coal, 6 cents per bushel, **86**, 1609.

**1887.** O'Brien & Co., lock stone, **87**, 1875.

**1888.** Mason, Gooch & Hoge Co., furnishing lock stone, $87,238, **89**, 1972.

**1889.** G. S. Adams, cement, $1.21 per barrel, **89**, 1973. Choate & Brawner, 3 lock houses, $2,041 each, **89**, 1978.

**1890.** D. K. Sprinkle, construction of 2 dump scows, $1,750 each, and dredge-boat hull, $2,590, **90**, 2269.

**1891.** E. W. Fisher, Portland cement, $2.68 per barrel, **91**, 2450. J. B. Speed & Co., American natural cement, $1.01 per barrel, **91**, 2450.

**1892.** C. Barnes, constructing tow-boat, $16,800, **93**, 2619.

**1896.** M. P. Grey, moving stone, $7.68 per c. y. ($38,400). J. B. Speed & Co., cement, $1.07 per barrel ($4,280). J. C. Thomas, stone, special, $14.50 per c. y.; coping, $13 per c. y.; backing, $5.50 per c. y. ($47,437), **96**, 2289.

**1897.** Enterprise Lumber Co., white oak or yellow-pine timber, $16.40 per M f. b. m. ($12,086.80). J. P. McGuire, iron work, $2,557.68. **97**, 2515.

**1898.** E. J. Young, four sets of lock-tender's houses at locks Nos. 7 and 8, $11,232. T. A. Sheridan, masonry of lock and abutment, lock No. 8, $188,397.50. **99**, 2515, 2516.

**1899.** T. A. Sheridan, lock gates for lock No. 8, $7,679.30; timber-crib dam and approach cribs, lock No. 8, $30,800, **99**, 2517.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 109; **79**, 146, 147; **80**, 195; **81**, 263; **82**, 257; **83**, 265; **84**, 264, 1728; **85**, 288; **86**, 282; **87**, 247; **88**, 226, 227; **89**, 263, 264; **90**, 237, 238; **91**, 305, 306; **92**, 291, 292; **93**, 331; **94**, 303; **95**, 338; **96**, 295; **97**, 373; **98**, 355; **99**, 437; **1900**, 500.

BOARDS OF ENGINEERS.

Convened at Cincinnati, Ohio, Nov. 19, 1883, by S. O. No. 146, C. of E., to report upon the erection of a lock and movable dam at junction of the "Three Forks of Kentucky River." Report, **84**, 1729, 1731. (Lt. Cols. Craighill and Merrill and Capt. Post.)

Convened at Frankfort, Ky., Mar. 9, 1887, by S. O. No. 23, to examine and report upon Maj. Post's project for lock and dam No. 6. Report, **87**, 1879. (Lt. Cols. Poe and Merrill and Maj. Stickney.)

Convened at Washington, D. C., May 30, 1887, by S. O. No. 146, to report upon the subject of modifications required for remedying the difficulties experienced in passing boats through the chutes of the movable dam at Beattyville. Report, **87**, 1882. (Col. Craighill, Lt. Col. Merrill, and Maj. Post.)

ENGINEERS IN CHARGE:

Maj. W. E. Merrill, 1879–80; **80**, 195. Report, **79**, 1398.

Maj. J. W. Cuyler, 1880–83. Reports, **80**, 1825; **81**, 1971; **82**, 1945.

Capt. J. C. Post, 1883–87. Reports, **83**, 1559; **84**, 1723, 1728, 1731; **85**, 1869, 1878; **86**, 1603, 1610.

Maj. A. Stickney, 1887. Reports, **87**, 1872, 1885.

Maj. D. W. Lockwood, 1888–95. Reports, **88**, 1769, 1775; **89**, 1970, 1975; **90**, 2261, 2266; **91**, 2449, 2455; **92**, 2083, 2091; **93**, 2618; **94**, 1980; **95**, 2484.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2286; **97**, 2513.

Capt. J. G. Warren, 1898. Report, **98**, 2012.

Capt. G. A. Zinn, 1899.

Capt. H. C. Hodges, 1899–. Reports, **99**, 2513; **1900**, 3363.

ASSISTANTS:

R. H. Fitzhugh. Reports, **79**, 1399, 1407.

D. L. Sublett. Reports, **84**, 1726; **85**, 1876; **86**, 1613.

R. S. Burnett. Reports, **87**, 1875, 1889; **88**, 1772, 1777; **89**, 1973, 1978; **90**, 2264, 2269; **91**, 2450, 2457; **92**, 2085, 2092.

Lt. H. E. Waterman. Reports, **93**, 2619; **94**, 1981; **95**, 2485.

Lt. W. W. Hartz. Reports, **96**, 2290; **97**, 2516.

J. M. G. Watt. Reports, **98**, 2015; **99**, 2518; **1900**, 3365.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Merrill. Repairs of old and construction of new locks and dams, $1,074,402; slack-water system on North Fork, $1,386,000; improvement of channel North Fork, $10,000; slack-water system on Middle Fork, $786,000; slack-water system on South Fork, $968,000; **79**, 1399, 1401, 1411.

Tables of estimates, by R. H. Fitzhugh, **79**, 1411-1421.

**Legal proceedings.**

Difficulty in obtaining title to land for site of lock No. 7, **94**, 1980; **95**, 2485. Purchase of some of the land; some acquired by condemnation proceedings, **96**, 2287.

Title secured to lock No. 8, **98**, 2016.

Proceedings for site of lock No. 9, not concluded, **1900**, 3364,

**KENTUCKY RIVER AND ITS TRIBUTARIES, KY. (Including North Fork, Boone Fork, Middle Fork, Troublesome Creek, and South Fork)**—Continued.

**Obstructions.**

The Beattyville Dam an obstruction since the construction of a railroad from the dam to the Kentucky Union R. R., **93**, 2618.

**Operations.**

**1879–80.** Removal of State dams Nos. 1, 2, and 3 nearly completed, **80**, 1826.

**1880–81.** New dam half completed upon site of dam No. 1; 130-f. breach in dam No. 2 closed by crib work; new dam nearly completed on site of dam No. 3; new upper gates built for dam No. 4; repairs to lock houses; construction of quarter boats and derricks, **81**, 1793, 1794.

**1881–82.** Breach through bank above abutment at dam No. 1 repaired, **82**, 1947.

**1882–83.** Old gates removed and grounds inclosed at lock No. 5; guard cribs built and filled with stone; extensive repairs to old dam at lock No. 4; guard cribs and lower end of stone abutment raised, and lower river crib lengthened at lock No. 3; dam at lock No. 2 completed; work in breach at lock and dam No. 1 capped by 196 l. f. of crib work filled with stone; 675 l. f. guard cribs built above and below lock; gap below dam permanently closed by piling, brush, and crib work, **83**, 1560.

**1883–84.** Dam No. 1 resheeted and sheet piling placed in rear of same; leak in dam No. 2 repaired; 528 l. f. new apron constructed at dam No. 4, **84**, 1724.

**1884–85.** Outlet to breach at lock and dam No. 1 raised and 5,000 c. y. backing placed behind the dam; bar below lock removed; stone crib built; lock chamber and upstream approach cleaned at dam No. 5; miter sills rebuilt; walls and coping repaired; guard cribs reconstructed; gates framed and new abutment built; 169 snags removed and 1,200 trees cut and girdled, **85**, 1869, 1871.

Operation and repair of locks and dams, **85**, 1878.

**1885–86.** Lock keeper's dwelling completed at dam No. 1; reconstruction of dam No. 5 completed and repairs made to lock and approaches; work commenced on the foundations for movable dam and abutment at Beattyville; 29,769 c. y. gravel, 9,354 c. y. of rock, and 7,316 snags removed; 10,808 l. f. wing dams built, **86**, 1604, 1605.

Operations and repair of locks and dams, **86**, 1610.

**1886–87.** Construction of Beattyville Dam continued to completion; re-[illegible] obstructions continued by the [illegible] **87**, 1873.

Operation and repair of locks and dams, **87**, 1885.

**1887–88.** Crest, upper steps, portions of guide walls, and floors of passes of Beattyville Dam removed; channel 100 f. wide and 350 f. long cut through high bar below the chutes; 378 l. f. of protection wall built along Proctor bank below passes; quarry stripped and track laid for stone for lock No. 7, **88**, 1772–1774.

Operation and repair of locks and dams, **88**, 1775–1786.

**1888–89.** Removal of guide walls of Beattyville Dam continued; protection wall along the Proctor bank raised 3 f.; quarrying stone for lock No. 7 begun; repair and construction of plant, **89**, 1973, 1974.

Operation and repair of locks and dams, **89**, 1975–1982.

**1889–90.** Removal of guide walls, gates, and floors of Beattyville Dam continued; cofferdam built; lower wing of Beattyville abutment strengthened by cribbing; 1,555 c. y. dimension stone cut, and 215 c. y. special stone prepared; 336 c. y. backing quarried, **90**, 2264, 2265.

Operation and care of locks and dams, **90**, 2266.

**1890–91.** Dredge built; dredging and excavation for cofferdam; excavation for abutment, and construction and erection of plant for lock No. 6, **91**, 2450. 37,000 c. y. dredged, **91**, 2453. Construction of Beattyville Dam continued, **91**, 2454.

Operation and repair of locks and dams, **91**, 2455.

**1891–92.** Lock and dam No. 6 completed; Beattyville Dam extended to Proctor side of the river; 2,947 c. y. rock blasted and removed, and 852 c. y. of sand dredged, **92**, 2083, 2084.

Operation and repair of locks and dams, **92**, 2091.

**1892–93.** Construction of lock No. 6 and its approaches in progress; about 15,000 c. y. dredged, and much general work done, **93**, 2620, 2621.

**1893–94.** Work on lock No. 6 in progress; preparations made for work on lock No. 7; a small amount of dredging done; general work done, **94**, 1981, 1982.

**1894–95.** General work at lock No. 6; construction of 2 barges in progress and nearly completed at lock No. 4; work at lock No. 7 in progress, **95**, 2488.

**1895–96.** Construction of lock No. 7 in progress, involving among other kinds of work the dredging of over 37,000 c. y., **96**, 2290–2292.

**1896–97.** Work on lock and dam No. 7 in progress, **97**, 2516–2519.

**1897–98.** Same work as last year,

## KENTUCKY RIVER AND ITS TRIBUTARIES, KY. (Including North Fork, Boone Fork, Middle Fork, Troublesome Creek, and South Fork)—Continued.

and plans prepared for construction of lock and dam No. 8, **98**, 2017–2021.

**1898–99.** Four houses built for lock tenders at locks Nos. 7 and 8; finishing the paving and miscellaneous work at lock No. 7; purchasing the site and beginning work at lock No. 8, **99**, 2514.

**1899–1900.** Two coal bins built; cribs and culvert at lock No. 7 finished; masonry and cribs at lock No. 8 nearly finished, and about 15,400 obstructions removed from pool of lock No. 8, **1900**, 3363.

**Physical characteristics.**

Description, **79**, 1398–1408.

Mineral, timber, and stone resources tributary to river, **79**, 1401–1403.

Tables of distances and elevations, **79**, 1411–1421.

A tributary of the Ohio, entering it between Cincinnati, Ohio, and Louisville, Ky., **93**, 2618.

Description of, at lock No. 7, **95**, 2484–2487; **96**, 2287.

Description of, upper river, **98**, 2013.

**Plans.** (See *Estimates* and *Projects.*)

**1879.** By Maj. Merrill, slack-water navigation, North Fork, 121 miles, 14 locks and dams, average lift, 14.5 f. per lock; estimate, $1,386,000; and for removing old mill dams and other obstructions to a point 44 miles above Leatherwood Creek; estimate, $10,000. Slack-water navigation up Middle Fork, 68 miles, 13 locks and dams, average lift of 13 f.; estimate, $786,000. Slack-water navigation, 69 miles up South Fork, 14 locks and dams, average lift, 15 f.; estimate, $968,000. **79**, 1399.

By R. H. Fitzhugh, repairing and constructing locks and dams, **79**, 1400, 1406, 1421.

**Private (State) work.**

Kentucky improved the lower 95 miles of river with 5 locks and dams (in a dilapidated condition), **79**, 146, 1398.

Description of work done before acquirement of control by the United States, **96**, 2286.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Merrill, 1879, slack-water navigation for a draft of 6 f. on Kentucky River, mouth to Three Forks, 258 miles, repairing old locks and dams, and constructing 12 new locks and dams; estimate, $1,074,402, **79**, 1399; **80**, 1826.

In 1883, after a total appropriation of $550,000, Capt. Post revised the estimate and concluded that $2,471,639.26 would be required to complete the project, **83**, 1562.

Plan and location of lock and dam No. 6, as proposed by Maj, Post, approved by Board of Engineers of 1887, **87**, 1880. The Board of Engineers of 1887 considered that the chutes at the Beattyville movable dam did not meet the requirements of navigation, and that the stone lock and dam originally contemplated should be substituted therefor, **87**, 1881, 1884.

By Maj. Lockwood, 1893–94, building lock No. 7 a short distance below Highbridge, **94**, 1980.

In 1893, Maj. Lockwood estimated that by increasing the lift of the locks above No. 6 navigation could be extended to Three Forks, with nine additional dams and locks; estimated cost, $2,740,782.30. Estimate, lock No. 7, in course of construction, $300,000, **96**, 2287; **98**, 2013.

In 1894 the Chief of Engineers sanctioned the use of the stone cut for the Beattyville dam to construct lock No. 7, **96**, 2287.

In 1898, Capt. Warren believed that by increasing the lift of the remaining locks to be built to 18 feet, only seven more locks would be required, which would cost $4,865,550 as against $5,179,200 for locks, etc., with 15-foot lift. In the same year the Chief of Engineers approved the plans, etc., for constructing lock No. 8, providing for a lift of 18 feet, **98**, 2015.

Capt. Hodges estimated, 1899, it would cost $2,560,000 in excess of the sums appropriated to complete the project, **99**, 438.

Capt. Hodges, 1899–1900, reported that the cost of the complete improvement would exceed, by a large sum, the limit of authority for continuing contracts, and that this limit would probably be reached while the last four locks and dams would be untouched or incomplete, **1900**, 501.

**Surveys.**

By R. H. Fitzhugh, surveys of the North Fork, Boone Fork, Troublesome Creek, Middle and South Forks, and the main stream, **78**, 109; **79**, 147, 1398, 1399, 1407.

For location of lock and dam at Beattyville, **83**, 1560.

Of open river from Oregon to Beattyville, **85**, 1871.

Surveys for lock No. 7, **94**, 1980; **95**, 2485; lock No. 8, **98**, 2021; lock Nos. 9 and 10, **99**, 2514.

Bench Marks. Hickman to lock No. 6, **95**, 2486. Above Hickman, **96**, 2487.

MAPS. **83**, 1562; **84**, 1744, 1746.

## KENTUCKY RIVER, KY., LOCKS AND DAMS. (Care and operation.)

**Appropriation.**[a]

| | |
|---|---|
| 1885, | $12,104.65 |
| 1886, | 23,174.28 |
| 1887, | 31,384.97 |
| 1888, | 89,427.21 |
| 1889, | 79,643.24 |
| 1890, | 51,123.29 |
| 1891, | 44,462.21 |
| 1892, | 48,759.14 |
| 1893, | 46,429.08 |
| 1894, | 54,765.96 |
| 1895, | 41,757.76 |
| 1896, | 67,677.93 |
| 1897, | 71,552.03 |
| 1898, | 49,084.03 |
| 1899, | 39,887.38 |
| 1900, | 58,726.97 |
| Total, | 809,960.13 |

**Contracts.**

List of expenditures.

See each annual report.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 332; **94**, 304; **95**, 339; **96**, 296; **97**, 375; **98**, 356; **99**, 439; **1900**, 502.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1888–95. Reports, **93**, 2622; **94**, 1983; **95**, 2489.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2292; **97**, 2519.

Capt. J. G. Warren, 1898–99. Report, **98**, 2024.

Capt. G. A. Zinn, 1899.

Capt. H. F. Hodges, 1899–. Reports, **99**; 3523; **1900**, 3369.

ASSISTANTS:

Lt. H. E. Waterman. Reports, **93**, 2625; **94**, 1986; (Capt.), **95**, 2492.

Lt. W. W. Harts. Reports, **96**, 2296; **97**, 2519.

J. M. G. Watt. Reports, **98**, 2030; **99**, 2536; **1900**, 3383.

**Legal proceedings.**

Leases and collections, **93**, 2623; **94**, 1984; **95**, 2490; **96**, 2294; **97**, 2526.

**Obstructions.**

In 1893 plans were approved by the Secretary of War for raising the height of the Louisville & Nashville R. R. bridge and a highway bridge, both at Frankfort, Ky., and preparations made for the completion of the work by the proper parties, **93**, 2625; **94**, 1986; **95**, 2492; **96**, 2296. The pool at that locality was lowered several times to permit the removal of three bridge piers to a depth of 7 f. below the pool, **95**, 2492; **96**, 2296.

Bridges obstructing navigation required to be lighted in accordance with the regulations of the Light-House Department, **96**, 2296.

**Operations.**

**1892–93.** In this year and subsequent years the same general work was performed, consisting generally of repairs of locks and dams, dredging, snagging. See each annual report.

**1897–98.** Lock and dam No. 7 opened to navigation on Dec. 11, 1897, **98**, 2030–2034.

**Physical characteristics.**

Gauge readings, **93**, 2626–2628; **94**, 1987–1989; **95**, 2493–2499; **96**, 2296–2298; **97**, 2520–2522; **98**, 2031–2033; **99**, 2538; **1900**, 3386.

Washouts, **95**, 2489; **96**, 2293.

Description of sites of locks located, **99**, 2523.

**Private work.**

Description of work constructed before acquirement of control by the United States, **95**, 2490; **96**, 2292.

## KEWAUNEE HARBOR, WIS.[b]

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $5,000, | **81**, 2081. |
| 1882, | 12,000, | **82**, 2142. |
| 1884, | 18,000, | **84**, 1850. |
| 1886, | 10,000, | **86**, 1665. |
| 1888, | 10,000, | **88**, 1849. |
| 1890, | 20,000, | **90**, 2341. |
| 1892, | 30,000, | **92**, 2188. |
| 1894, | 20,000, | **95**, 2621. |
| 1896, | 25,000, | **96**, 2487. |
| 1899, | 8,800, | **99**, 2755. |
| Total, | 158,800 | |

**Commerce.**

Small and local, but the harbor connected by a railway with large trunk lines, **1900**, 3757.

**Contracts.**

**1881.** Green Bay Dredge & Pile Driver Co., pier extension, **81**, 2081.

**1882.** Hanson & Scove, pile-pier construction, **83**, 1683.

**1884.** Schwarz & Berner, pile-pier construction, **85**, 1993.

**1886.** Schwarz & Berner, pier extension, **87**, 2041.

**1888.** Knapp & Gillen, construction of 300 l. f. of pile pier, $7,968, **89**, 2057.

**1890.** J. M. Borgman, pier extension, $9,239, **91**, 2542.

**1892.** J. M. Borgman, extension of 550 l. f. of pier, $21,528.81, **93**, 2725.

**1894.** McGrath & Anderson, extension of pile piers, 400 l. f., actual average cost, $36.20 per l. f., **95**, 2622; **96**, 2487.

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[a] Expenditures under permanent indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

Survey.—Report Nov. 1, 1837, estimate, $97,195.75. (H. Doc. No. 482, 55th Cong., 2d sess.)

## KEWAUNEE HARBOR, WIS.—Continued.

**1896.** T. J. McGrath, pile-pier extension, 425 l. f., actual average cost, $37.74 per l. f., **97**, 2677; **98**, 2313.

**Engineers.**

Chief of Engineers. Reports, **73**, 36; **80**, 207; **81**, 276, 279; **82**, 272; **83**, 281; **84**, 280; **85**, 303; **86**, 297; **87**, 263; **88**, 239; **89**, 278; **90**, 251; **91**, 322; **92**, 308; **93**, 350; **94**, 322; **95**, 360; **96**, 315; **97**, 399; **98**, 390; **99**, 463, 474; **1900**, 528, 538.

Engineers in Charge:

Lt. Col. H. M. Robert, 1880–83. Reports, **81**, 2080, 2082; **82**, 2141.

Maj. J. W. Barlow, 1883. **83**, 274.

Capt. F. A. Hinman, 1883–84. Report, **83**, 1682.

Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1849; **85**, 1993.

Capt. C. E. L. B. Davis, 1886–92. Reports, **86**, 1663; **87**, 2040; (Maj.), **88**, 1848; **89**, 2055; **90**, 2340; **91**, 2540.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2187; **93**, 2724; **94**, 2066.

Capt. C. F. Palfrey, 1895. Report, **95**, 2620.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2486; **97**, 2675; **98**, 2312.

Capt. J. G. Warren, 1899–. Reports, **99**, 2754; **1900**, 3679, 3752, 3755.

Assistant. L. Y. Schermerhorn. Report, **81**, 2084.

**Legal proceedings.**

The city of Kewaunee granted, 1896–97, a piece of land 120 by 265 f. for a place in which to lay up the Government plant during winter, **97**, 2676. Additional grants of land, **99**, 2754; **1900**, 3680.

By deed of gift in 1897 the title to the land occupied by the harbor piers was deeded to the U. S. by the owner and his wife, **98**, 2313.

**Operations.**

**1880–81.** Pier construction commenced under contract, **81**, 2080.

**1881–82.** 250 l. f. pile pier built on north side and 275 f. on south side, **82**, 2141.

**1882–83.** 100 l. f. revetted pile pier built, **83**, 1683.

**1883–84.** 350 l. f. north pile pier built, **84**, 1850.

**1884–85.** Work on south pile pier continued, **85**, 1993.

**1885–86.** South pile pier extended 500 f.; 116,976 c. y. dredged from channel by U. S. dredge, **86**, 1664.

**1886–87.** 100 l. f. pier extension wholly and 150 partially completed; 9,035 c. y. dredged from the harbor, **87**, 2040.

**1887–88.** North pile pier extended 200 f. under contract, **88**, 1848.

**1888–89.** 7,280 c. y. dredged from channel between the piers by hired labor; 100 l. f. of south pile pier completed under contract, **89**, 2056.

**1889–90.** 200 l. f. of south pile pier built under contract; 15 cords stone deposited in breach protection by hired labor, **90**, 2340.

**1890–91.** 77,790 c. y. dredged; construction of pile-pier work begun, **91**, 2541.

**1891–92.** North pier extended 250 f. and south pier 50 f., **92**, 2187.

**1892–94.** Construction of pile pier in progress, 27,492 c. y. dredged, dredging plant repaired, **93**, 2724; north pier extended 250 l. f. and south 300 l. f.; 22,425 c. y. dredged; harbor piers and dredging plant repaired, **94**, 2067.

**1894–95.** Pier extension in progress; dredging plant repaired, **95**, 2620.

**1895–96.** North and south piers extended 200 l. f. each in connection with previous year; harbor piers and dredging plant repaired, **96**, 2487.

**1896–98.** Extension of piers in progress; 74,825 c. y. dredged; frame warehouse built, and 135 l. f. dock built, **97**, 2675, 2676; 200 l. f. north and 225 l. f. south pier extended; 25,701 c. y. dredged, a scow and ways for building other scows built, and minor repairs made, **98**, 2312, 2313.

**1898–99.** Plant repaired; 13,609 c. y. dredged, **99**, 2754.

**1899–1900.** 21,315 c. y. dredged; plant repaired and increased; 325 l. f. superstructure of piers rebuilt, **1900**, 3679.

**Physical characteristics.**

Channel subject to constant deterioration from sediment deposits, **97**, 2676; **98**, 2313.

Description of, **1900**, 3755.

**Plans.** (See *Projects.*)

For pile and crib piers to 18 f. water, with revetment of "cut" and dredging 100,000 c. y., at estimated cost of $200,000 (not justified by the requirements of commerce), **73**, 258.

**Private (city and private) work.**

$8,000 raised in Kewaunee and West Kewaunee to aid in work of improvement, **81**, 2080.

Total appropriations by local authorities in aid of improvement, **89**, 2056.

5,231 c. y. dredged from inner harbor by city of Kewaunee and private parties, **89**, 2056.

**Projects.** (See *Plans.*)

By Maj. Robert, 1881, two parallel pile and crib piers, 1,650 f. long each and 200 f. apart, shore line to the 18 f. curve, and located where the Kewaunee River first approaches the lake and turns to the north; also dredging in the channel between the

## KEWAUNEE HARBOR, WIS.—Continued.

piers and interior basin; estimate, $200,000; **81**, 2083, 2084; **91**, 2541; **92**, 2187.

Capt. Warren estimated, 1899, it would cost $230,000, and probably $1,500 per annum for maintenance, to further improve the harbor, **1900**, 3753.

**Surveys.**

Previous survey by U. S. Lake Survey in 1866, **73**, 259.

Survey ordered by act of Mar. 3, 1873, made, under direction of Maj. Houston (report, **73**, 258), by J. Pierpont, report, **73**, 258.

Ordered by act of June 14, 1880, made, 1881, under direction of Maj. Robert, **81**, 2082.

Minor surveys. (See each annual report.)

Examination and survey for 20 f. harbor of refuge ordered by act of Mar. 3, 1899, made by Capt. Warren, 1899 (report unfavorable to immediate improvement), **1900**, 3753.

MAPS. **81**, 2084; **88**, 1848; **93**, 2724; **97**, 2676.

## KEWEENAW BAY, MICH. (Waterway, from to Lake Superior, Portage Lake, and Lake Superior Ship Canal.) (See *Portage Lake, Mich.*)

**Appropriations.**

| | | |
|---|---|---|
| 1886, | $10,000, | **86**, 456. |
| 1890, | [a] 20,000<br>[b] 350,000 | **92**, 2166. |
| 1892, | 50,000 | |
| 1894, | 130,000, | **95**, 2563. |
| 1896, | 50,000, | **96**, 2260. |
| 1897, | 350,000, | **97**, 2611. |
| 1898, | 450,000, | **98**, 2246. |
| 1900, | 110,000, | **1900**, 3601. |
| Total, | 1,520,000 | |

**Commerce.**

National importance of route, **87**, 1977.

Tonnage and freight passing the Sault Ste. Marie and St. Marys Falls canals from 1881 to 1890, inclusive, **92**, 2159.

The waterway considered an important link in the chain of lake commerce. (See references above.)

During the season of 1894 it amounted in value to $28,099,533, **95**, 2562; 1899, to $55,000,000, **1900**, 3600.

**Contracts.**

**1892.** Williams, Daugherty & Upham, dredging, 25 cents per c. y., **92**, 2164.

Details of expenditures for operation and maintenance, etc. (See each annual report.)

**1892–93.** J. Pryor, dredging, 18½ and 24½ cents per c. y.; use of dredging plant $10 per hour; revetment repairs, $6,581, **93**, 2680; **94**, 2031.

**1894.** Williams, Daugherty & Upham, dredging, 13½, 15, and 20 cents per c. y.; use of dredging plant, $10 per hour, **95**, 2565. McKenzie, Somerville & Milberry, pier revetment repairs, $7.45 per l. f. A. and D. Sang, pier repairs, timber, stone, etc., $8,435.50, **95**, 2566.

**1895.** Wisconsin Dredge & Dock Co., pier repairs, timber, stone, etc., $13,394.96, **95**, 2567. McCurdy & McCurdy, revetment repairs, timber, stone, etc., $4,866.26, **95**, 2568. D. S. Blanchard, revetment repairs, timber, $18.50 per 1,000 f., b. m.; sheet piles, $17 per 1,000 in place; round piles, 15 cents per l. f. in place, **96**, 2361.

**1896.** J. Pryor, dredging, 15 and 24½ cents per c. y.; use of plant, $10 per hour ($4,225), **96**, 2361. C. S. Barker, dredging, 11 and 15 cents per c. y.; use of plant, $9 per hour ($28,000), **97**, 2611.

**1897.** Powell & Mitchell, pier extension: Norway pine superstructure, $39.10 per l. f.; white pine superstructure, $40 per l. f.; if small stone should be used instead of mattresses, 40 cents per l. f. to be deducted, **97**, 2612. McCurdy Bros., revetment repairs, $2,500, **98**, 2248.

**1898.** Porter Bros., pier extension, Norway pine, $280,953.20; white pine, $288,639.60; exclusive of stamp sand in place, at 70 cents per c. y., **98**, 2247.

**1899.** Hingston & Woods, widening upper canal by dredging, 9 and 11 cents per c. y. ($165,000). F. P. Tims, pile-revetment work, $60,350, **99**, 2710.

**1900.** Hugo & Tims, revetment work, $132,273.50, **1900**, 3602.

**Encroachments.**

Injury to harbor at Hancock and Houghton from sand deposits of the stamp mills, **83**, 1697, 1698.

**Engineers.**

CHIEF OF ENGINEERS.

Reports, **80**, 206; **85**, 332, 2170; **87**, 257, 1973, 1975; **91**, 17; **92**, 302; **93**, 341, 342; **94**, 312; **95**, 349; **96**, 305, 306; **97**, 389, 390; **98**, 382, 383; **99**, 452, 453; **1900**, 517, 518.

BOARD OF ENGINEERS. Constituted by S. O. No. 112, C. of E., 1886, to report upon limiting shore lines at Portage

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[a] For maintenance of canals.

[b] For purchase of Portage canals.

## KEWEENAW BAY, MICH. (Waterway, from to Lake Superior, Portage Lake, and Lake Superior Ship Canal)—Continued.

Lake. Report, **87**, 1972. Also upon the expediency of the acquisition of the Portage Lake and Lake Superior Ship Canal. Report, **87**, 1977. (Col. Abbot, Majs. Ernst and Allen.)

ENGINEERS IN CHARGE.

Lt. Col. H. M. Robert, 1880–83. Reports, **80**, 1925; **83**, 1696.

Lt. Col. O. M. Poe, 1884–85. Report, **85**, 2170.

Capt. C. E. L. B. Davis, 1887. Report, **87**, 1971.

Maj. J. F. Gregory, 1891–92. Report, **92**, 2158.

Maj. C. B. Sears, 1893–. Reports, **93**, 2680; **94**, 2029; **95**, 2561; **96**, 2357; **97**, 2608; **98**, 2244; **99**, 2707; **1900**, 3598.

ASSISTANTS.

L. Y. Schermerhorn. Reports, **80**, 1926; **83**, 1698.

G. A. Marr. Report, **87**, 1989.

Lt. H. E. Waterman. Report, **92**, 2166.

**Legal proceedings.**

Land purchases, **93**, 2681. Condemnation proceedings for land required, **1900**, 3599.

Rules and regulations for the use of the canals approved by the Secretary of War. Difficulty of enforcing them because of no legal penalty for their violation, one case having been decided against the United States in court. **93**, 2682; **94**, 2030.

Rules and regulations for the government of navigation in the waterways issued by the Secretary of War under authority of act of 1894 of salutary effect. Copy of the rules, etc. **95**, 2563.

**Legislation.**

Act of September 19, 1890, providing for the close of the canals, **91**, 17.

**Obstructions.**

The railroad and wagon bridge across Portage Lake between Houghton and Hancock an obstruction because of the narrow openings. Recommendations made that the pontoon, drawspan, and the central pier be removed entirely, **96**, 2360; **97**, 2610; **98**, 2246.

**Operations.**

**1891–92.** 14,300 c. y. dredged from Lake Superior Canal entrance, **92**, 2165. History of the Portage Lake canals, **92**, 2160.

**1892–93.** Dredging in progress, **93**, 2680.

**1893–94.** Dredging completed and revetment repaired, **94**, 2029.

**1894–95.** Dredging and repair of piers and revetment construction in progress, **95**, 2561.

**1895–96.** In connection with preceding year 168,000 c. y. dredged and other work completed. Bank revetment constructed, **96**, 2358. About 40,000 c. y. dredged in maintenance, **96**, 2360.

**1896–97.** 144,100 c. y. dredged, plans, etc., prepared for breakwater piers at Superior entrance, **97**, 2609, and 48,000 c. y. dredged in maintenance, **97**, 2610.

**1897–98.** Pier extension in progress, breakwater pier construction in progress, 291,380 c. y. dredged, and canal revetment repaired, **98**, 2245.

**1898–99.** Dredging and pier work in progress; miscellaneous work of operating and care of works, **99**, 2708.

**1899–1900.** 3,800 l. f. old pile revetment removed and temporary crib bulkhead built. In connection with preceding year 2,800 l. f. pier extension built and 883,000 c. y. dredged, 7,452 l. f. revetment constructed, 900 l. f. west pier, 330 l. f. crib foundation, and 400 l. f. cribs built, 794,417 c. y. dredged from Lily Pond; miscellaneous work of operating and care of works, **1900**, 3599.

**Physical characteristics.**

The navigability of the waterway greatly bettered since the U. S. took charge, **93**, 2681.

Bar formation at the entrance has to be removed nearly every spring, **95**, 2562; **99**, 2709.

**Plans.** (See *Projects.*)

By Maj. Robert, 1880, extension of piers 330 f., to a depth of 18 f., extension to be parallel to existing piers, but with a width increase to 400 f., the outer ends of piers to be connected with proposed extension by fender pilings; estimate, $74,712; by changing detail of construction, $70,994, **80**, 1927, 1928.

By Board of Engineers, 1886, establishment of limiting shore lines at Portage Lake, **87**, 1972.

Regulations for establishment and maintenance of lines proposed, **87**, 1974. (See *Legal proceedings.*)

The Board of Engineers, 1886, recommended that the offer of the company to transfer all their rights to the U. S. for $350,000 be accepted, and that the route be made a free waterway; also that a navigable depth of 16 f. for a minimum width of 70 f. be obtained, by dredging, throughout the whole extent of the route, **87**, 1975, 1976, 1988.

**Private (corporate) work.**

Description of its canal and its cost as built by the canal company, **85**, 2170; **87**, 1789, 1980, 1985.

Present condition of the improvement, **85**, 2170; **87**, 1982.

## KEWEENAW BAY, MICH. (Waterway, from to Lake Superior, Portage Lake, and Lake Superior Ship Canal)—Continued.

Value of the improvement, **85**, 2173, 2175; **87**, 1985.

Recommended purchase by the U. S., **87**, 1975, 1976, 1988.

**Projects.**

Under act of Sept. 19, 1890, the works were purchased by the U. S. Control was assumed on Aug. 3, 1891. **92**, 2158. The act provided for expending $10,000 each year for two years for preserving and continuing the use of the canal, **92**, 2163.

By Maj. Sears, 1892, for expending the appropriation of 1892, $50,000, in dredging to a depth of 16 f. and width of 70, and also for repairing existing revetments, **93**, 2680; and for expenditure of allotments for maintenance and operation in maintaining a depth equal to the depth of the Sault Ste. Marie Canal, and for miscellaneous work incident to care and maintenance, **93**, 2681; **94**, 2029; **95**, 2562; **96**, 2359; **97**, 2610; **98**, 2246. (See each annual report.)

The lighting and buoying of the waterway transferred to the custody of the Light-House Board in 1894, **95**, 2562.

Act of June 3, 1896, authorized continuous contracts amounting to $1,065,000, **96**, 2359; **99**, 2707.

**Surveys.**

Survey ordered by act of Mar. 3, 1879, **79**, 155.

Maps. **92**, Atlas, 102; **93**, 2682; **96**, 2364.

## KEWEENAW BAY, MICH. Waterway to Lake Superior. (Operating and care.)

**Appropriations.**[a]

| | |
|---|---|
| 1893, | $30,910.64 |
| 1894, | 11,647.00 |
| 1895, | 8,000.00 |
| 1896, | 11,500.00 |
| 1897, | 8,300.00 |
| 1898, | $8,300.00 |
| 1899, | 8,300.00 |
| 1900, | 8,300.00 |
| Total, | 95,257.64 |

## KEYPORT HARBOR, N. J. (See *Matawan Creek, N. J.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1882, | $30,475, | **83**, | 589. |
| 1892, | 5,000, | **92**, | 890. |
| 1894, | 5,000, | **95**, | 988. |
| 1896, | 2,500, | **96**, | 794. |
| 1899, | 2,500, | **99**, | 1311. |
| Total, | 45,475 | | |

**Commerce.**

Increase in commerce consequent upon improvement, **88**, 662.

Had increased up to 1892 to $6,562,200, **93**, 1124.

**Contracts.**

**1882-83.** Atlantic Dredging Co., dredging, 24 cents per c. y., **83**, 589.

**1893.** R. G. Packard, dredging, 28 cents per c. y., s. m. ($4.000), **93**, 1125.

**1895.** A. E. Smith, dredging, 20 cents per c. y., **95**, 987.

**1897.** W. H. Taylor, jr., dredging, 18 cents per c. y., s. m. ($2,200), **97**, 1149.

**1899.** W. H. Taylor, jr., dredging, 15½ cents per c. y., s. m. ($2,250), **99**, 1311.

**Engineers.**

Chief of Engineers. Reports, **72**, 80; **73**, 86; **83**, 111; **84**, 120; **85**, 111; **86**, 105; **87**, 73; **88**, 73; **89**, 93; **90**, 83; **91**, 104; **92**, 106; **93**, 114; **94**, 104; **95**, 116; **96**, 100; **97**, 135; **98**, 141; **99**, 160; **1900**, 183.

Engineers in Charge:

Lt. Col. J. Newton, 1872. Report, **73**, 941.

Lt. Col. G. L. Gillespie, 1883-86. Reports, **83**, 588; **84**, 758; **85**, 763.

Lt. Col. W. McFarland, 1886. Report, **86**, 760.

Lt. G. McC. Derby, 1886-89. Report, **87**, 776; (Capt.) **88**, 662.

Capt. T. L. Casey, 1889-94. Reports, **89**, 839; **90**, 863; **91**, 1001; **92**, 889; **93**, 1123; **94**, 815.

Lt. Col. G. L. Gillespie, 1895. Report, **95**, 987.

Maj. H. M. Adams, 1896-97. Reports, **96**, 793; **97**, 1147.

Maj. A. M. Miller, 1898. Report, **98**, 1067.

Col. J. W. Barlow, 1899-. Reports, **99**, 1310; **1900**, 1511.

Assistants:

J. H. Striedlinger, **73**, 942.

A. Zoller, **73**, 942.

A. Doerflinger, **73**, 942.

**Operations.**

**1882-83.** 1,863 c. y. dredged from the channel, **83**, 589.

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[a] Expenditures under permanent-indefinite appropriation provided by act of July 5, 1884, for operating and keeping in repair canals and other public works.

## KEYPORT HARBOR, N. J.—Continued.

**1883–84.** 112,299 c. y. dredged from the channel, **84**, 758.

**1892–93.** 14,999 c. y. dredged, **93**, 1124.

**1895–96.** 20,339 c. y. dredged, **96**, 794.

**1896–97.** 12,222 c. y. dredged, **97**, 1148.

**1899–1900.** 14,500 c, y. dredged, **1900**, 1511.

**Physical characteristics.**

The bed of the harbor clay and fine sand. Maximum velocity of tidal current 0.50 knot per hour. Exposed to the waves during northerly gales. **73**, 941, 942.

Description of, **88**, 662.

Tidal observations, **93**, 1123.

Channel subject to shoaling, **95**, 988; **97**, 1148; **98**, 1067.

**Projects.**

By Lt. Col. Newton, 1873, channel, 4,700 f. in length, 200 f. in width, m. l. w. depth of 8 f.; estimate, $30,475, **73**, 942. Revised as to cost, 1884, to $40,475, **84**, 759; **87**, 776; **91**, 1002.

**Surveys.**

Under direction of Lt. Col. Newton, 1872–73, by J. H. Striedinger, A. Zoller, and A. Doerflinger. Report, **73**, 941.

Survey made by Capt. Casey in 1892, **93**, 1123.

## KEY WEST HARBOR, FLA.

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $25,000, | **83**, 972. |
| 1886, | 2,500, | **86**, 1145. |
| 1888, | 25,000, | **88**, 1093. |
| 1890, | 40,000, | **90**, 1580. |
| 1892, | 75,000, | **92**, 1376. |
| 1894, | 80,000, | **95**, 1548. |
| 1896, | 80,000, | **96**, 1326. |
| 1899, | 25,000, | **99**, 1611. |
| Total, | 352,500 | |

**Commerce.**

Benefit to commerce of improvement, **68**, 518.

Advantages that would follow the deepening of Northwest Bar, **89**, 1336.

**Contracts.**

**1883.** S. N. Kimball, dredging, $1.30 per c. y., **83**, 972.

**1890–91.** R. G. Ross, stone, $1.90 per c. y., **91**, 1641.

**1892.** R. G. Ross, stone, $2.58 per c. y., quarry chips, $2.40 per c. y. ($65,000), **93**, 1660.

**1894.** R. G. Ross, stone, $3.80 per s. t. ($38,000), **95**, 1548.

**1897.** R. G. Ross, stone, $1.57 per t., **97**, 1557.

**1899.** R. G. Ross, stone, $2.17 per t. ($32,550,) **99**, 1611.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **68**, 56; **81**, 189; **82**, 185; **83**, 187; **84**, 195; **85**, 195; **86**, 194; **87**, 156; **88**, 146; **89**, 168, 1328; **90**, 150, 582; **91**, 188; **92**, 186; **93**, 204; **94**, 189; **95**, 215; **96**, 192; **97**, 244; **98**, 248; **99**, 275; **1900**, 314.

BOARD OF ENGINEERS. Convened at St. Augustine, Jan. 31, 1889, to examine and report upon Capt. Black's plan for improvement of Key West Harbor. Reports, **89**, 1329; **90**, 1581, 1583. (Col. Abbot, Lt. Col. Hains, and Capt. Bixby.)

ENGINEERS IN CHARGE:

Col. J. H. Simpson. Report, **68**, 517, 520.

Maj. A. N. Damrell, 1881–85. Reports, **82**, 1314; **83**, 972; **84**, 1166.

Capt. W. T. Rossell, 1885–86. Report, **85**, 1267.

Capt. W. M. Black, 1886–92. Reports, **86**, 1144; **87**, 1221; **88**, 1092; **89**, 1324, 1333; **90**, 1578; **91**, 1640.

Maj. J. C. Mallery, 1892. Report, **92**, 1374.

Lt. A. M. D'Armit, 1893. Report, **93**, 1657.

Maj. T. H. Handbury, 1894–95. Reports, **94**, 1230; **95**, 1546.

Lt. Col. W. H. H. Benyaurd, 1896–97. Reports, **96**, 1325; **97**, 1555.

Lt. C. H. McKinstry, 1898–99. Reports, **98**, 1371, (Capt.) **99**, 1610.

Capt. T. H. Rees, 1900–. Report, **1900**, 1983.

ASSISTANTS:

Lt. W. R. Livermore. Report, **68**, 520.

T. L. Harrison. Report, **82**, 1315.

J. W. Sackett. Reports, **87**, 1226; **89**, 1326, 1333; **90**, 1594.

**Estimates.** (See *Plans* and *Projects*.)

By Col. J. H. Simpson, dredge and operating same four years, $165,941, **68**, 56, 520. For two dredges and operating same four years, $217,272, **68**, 56, 520.

**Operations.**

**1883–84.** 15,692 c. y. dredged from the cut through the bar in formation of a cut 60 f. wide and 15 f. deep, **84**, 1167; **87**, 1221.

**1886–87.** Survey of entrance to harbor, **87**, 1221.

**1890–91.** 1,160 c. y. stone deposited in jetty, **91**, 1641.

**1891–92.** 26,822 c. y. stone deposited in the jetty, **92**, 1375.

**KEY WEST HARBOR, FLA.**—Continued.

**1892–93.** 2,969 c. y. stone deposited in jetty, **93**, 1659.

**1893–94.** 20,862 c. y. stone deposited in jetty and Pinnacle Rocks removed from the main ship channel, **94**, 1231.

**1894–95.** 16, 336 tons of stone deposited in jetties, **95**, 1547.

**1895–96.** 1,000 tons of stone deposited, **96**, 1326.

**1897–98.** 14,980 tons stone deposited in westerly jetty, **98**, 1372.

**1898–99.** 28,416 tons stone deposited, **99**, 1610.

**1899–1900.** 10,503 tons stone deposited, **1900**, 1983.

**Physical characteristics.**

Description of, **68**, 518, 521; **87**, 1222.

Tidal volumes and velocities, **87**, 1223, 1229.

Description of Florida Keys, **88**, 1092; **89**, 1324.

Current observations, **89**, 1333; **90**, 1594.

**Plans.** (See *Estimates* and *Projects.*)

By Col. J. H. Simpson, channel 300 f. wide, 18 f. deep, and 9,000 f. long, **68**, 56, 519.

By Capt. Black, 1887, dike or breakwater along the west side of the bar. Estimate, $590,000. **87**, 1224, 1226.

**Projects.** (See *Estimates* and *Plans.*)

By Capt. Damrell, 1882, cut 300 f. wide at top and 17 f. deep at m. l. w., northwest channel; estimate, $140,000, **82**, 1314. Channel 60 f. wide and 15 f. deep formed in 1883–84, **84**, 1167; **87**, 1221.

By Capt. Black, 1887, formation and maintenance of a channel across the bar 17 f. deep at m. l. w., with a dike along its western side, rock removal and dredging; estimate, $608,000, **88**, 1093.

By Board of Engineers, 1890, stone jetty along the submerged reef on the northeast side of the Northwest Passage near its northerly end, the jetty to be raised approximately to the level of m. l. w.; a westerly jetty to be constructed if found necessary; estimate, $500,000, **90**, 1587; **92**, 1375.

By Lt. Col. Benyaurd, 1897, for the location of a westerly jetty, as provided in the original project of 1890, **97**, 1556.

**Surveys.**

By J. Rodgers, 1851, **68**, 521.

Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. Damrell, **82**, 1314.

Survey ordered by act of Aug. 5, 1886, made under direction of Capt. Black, **87**, 1221.

Survey of the bar made by Lt. D'Armit, 1895, **95**, 1547.

Survey made by Lt. Col. Benyaurd, 1896, **97**, 1556.

Survey made, 1900, by Capt. McKinstry (Maps), **1900**, 1983.

MAPS:

Of Northwest Channel Bar, **87**, 1234. **92**, Atlas, 66, 67; **93**, 1658; **95**, 1548; **96**, 1326; **99**, 1610; **1900**, 1984.

**KILL VAN KULL.** (See *Staten Island, New Jersey Channel.*)

**KIMACHI RIVER.** (See *Red River, Tex., Ark., and La.*)

**KINGSTON HABBOR, MASS.**

**Appropriation.**

1892, $10,000, **93**, 782.

**Commerce.**

Not unimportant, **91**, 686.

**Contracts.**

**1892.** National Dredging Co., dredging, 24 cents per c. y.; removal of bowlders over 3 t., $15 (37,500 c. y.), **93**,782.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 47; **93**, 50; **94**, 47; **95**, 52.

ENGINEER IN CHARGE. Lt. Col. S. M. Mansfield, 1890–95. Reports, **91**, 686, **93**, 781; **94**, 562; **95**, 637.

ASSISTANT. T. T. H. Harwood. Report, **91**, 688.

**Operations.**

**1892–93.** 30,000 c. y. dredged. Project completed. **93**, 781.

**Physical characteristics.**

Description of, **91**, 685.

**Projects.**

By Lt. Col. Mansfield, 1891, channel 6 f. deep at m. l. w. and 100 f. wide up to the Cordage Co.'s wharf in North Plymouth; estimate, $10,000, **91**, 687.

By Lt. Col. Mansfield, 1892, for the use of available funds to complete improvement, **93**, 781.

**Survey.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Lt. Col. Mansfield, **91**, 687.

MAPS, **91**, 688.

**KISKIMINETAS RIVER.** (See *Pittsburg, Pa.; Conemaugh River.*)

## KLAMATH RIVER, CAL.

**Commerce.**
Unimportant, **89**, 2497.

**Engineers.**
CHIEF OF ENGINEERS. Report, **89**, 352.
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1888. Report, **89**, 2495.

**Physical characteristics.**
Description of, **89**, 2495.

**Surveys.**
Examination ordered by act of Aug. 11, 1888, made 1888, under direction of Maj. Heuer (see *Commerce*), **89**, 2495.

## KLASKUINE RIVER. (See *Youngs and Klaskuine rivers, Oreg.*)

## KNOXVILLE. (See *Tennessee River.*)

## KOOTENAI RIVER, IDAHO AND MONTANA.

**Appropriations.**

| | | |
|---|---|---|
| 1896, | $5,000, | **96**, 3390. |
| 1897, | 5,000, | **97**, 3080. |
| Total, | 10,000 | |

**Commerce.**
Description of, **93**, 3457; **95**, 3490.

In 1892 there were indications that it would increase rapidly, **93**, 3458; **93**, 3456.

In 1895 the traffic from Jennings to the international boundary line of considerable importance, **97**, 3483.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **93**, 446; **95**, 458, 459; **96**, 417; **97**, 521, 523; **98**, 521; **99**, 612, 613; **1900**, 691.

ENGINEERS IN CHARGE:
Capt. T. W. Symons, 1893–95. Reports, **93**, 3456; **95**, 3489, 3515.
Capt. H. Taylor, 1896–. Reports, **96**, 3390; **97**, 3467, 3482; **98**, 3078, 3079; **99**, 3276, 3277; **1900**, 4500.

ASSISTANT. J. M. Clapp. Report, **99**, 3278.

**Operations.**
**1896–97.** About 160 snags and obstructions removed, **97**, 3467.
**1897–98.** About 400 snags removed, **98**, 3078; points which produced damming effect above Jennings cut off, and 1,859 c. y. rock removed, **98**, 3080.
**1898–99.** Nearly 300 c. y. rock removed, completing project for river above Jennings (maps), **99**, 3277.

**Physical characteristics.**
Description of, **93**, 3457; **95**, 3490; **97**, 3482.

The river rises in British Columbia, flows through Montana and Idaho into Kootenai Lake, thence into the Columbia River, of which it is one of the main branches. Fry, about 60 miles distant from the boundary line, is the head of navigation of the lower river. The country through which it passes is one of the richest in minerals in the world. For about 3 months in the year it freezes up. **93**, 3457.

Above Jennings navigation is impeded by rocks in the channel, **97**, 3482. Jennings is a small town situated where the river turns from its southerly course from British Columbia to the west, **95**, 3490.

**Projects.**
In 1895 Capt. Symons estimated it would cost $5,000 to improve the river between Bonners Ferry and the international boundary line, **95**, 3515; by the removal of snags and other obstructions; the project adopted, **96**, 3390.

In 1897 Capt. Taylor estimated it would cost $5,000 to improve the river above Jennings, **97**, 3483; by breaking up and removing rocks, and by cutting off points which produced damming effects, so as to reduce the velocity of the current and thereby enable boats to navigate with greater ease and less danger, adopted, **98**, 3079.

**Surveys.**
Examination from Fry to the international boundary line ordered by act of July 13, 1892, made in the same year by Capt. Symons (report favorable), **93**, 3456.

Examination from Jennings, Mont., to the international boundary line ordered by the Chief of Engineers in 1895, and made in that year by Capt. Symons (report favorable), **95**, 3489.

Survey of river between Bonners Ferry and the international boundary line, ordered by act of Aug. 17, 1894, made in that year by Capt. Symons (see *Projects*), **95**, 3515.

Survey with a view to the removal of snags above Jennings, ordered by act of June 3, 1896, made 1897, by Capt. Taylor (see *Projects*), **97**, 3482.

MAPS. **99**, 3278.

## LA BELLE HARBOR. (See *Lac La Belle Harbor, Mich.*)

## LAC LA BELLE HARBOR, MICH.

**Commerce.**
Important, **66**, iv, 90.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **66**, iii, 9, 34, iv, 86; **85**, 307.
ENGINEERS IN CHARGE:
Maj. W. F. Raynolds, 1866–67. Reports, **66**, iv, 85, 86, 90; **67**, 256.
Lt. Col. J. W. Barlow. Reports, **85**, 2005, 2007.

**Legislation.**
By act of Congress July 3, 1866, 100,000 acres of land granted to the State of Michigan to aid in construction of canal, dimensions to be at least 100 f. wide at top and 75 f. wide at bottom, and carrying at least 12 f. of water, **66**, iv, 86.

**Physical characteristics.**
General characteristics of locality, **66**, iii, 9, iv, 85, 86; **85**, 2006.
Light and unstable nature of the sand to be excavated, **66**, iii, 9, iv, 85, 86.

**Plans.**
By. Maj. Raynolds, 1866, sheet piling and dredging in canal cut, $92,000 (increased to $250,000 for pier extension and increased depth, **67**, 256), **66**, iii, 9, iv, 86.
By Col. Barlow, 1885, repairs to piers and canal built by a corporate company, and for deepening the channel by dredging between the piers and through the canal. Estimated cost, $25,000. Or for the construction of a harbor of refuge, providing for a channel of entrance thereto 18 f. deep. Estimate, $114,000. **85**, 2008, 2009.

**Private and corporate work.**
(See *Plans.*)
By the Lac La Belle Harbor Improvement Co., a canal 111 f. wide, and with a minimum depth of 8½ f., excavated, connecting the waters of Lake Superior and Lac La Belle, and 2 piers, covering the Lake Superior entrance of the canal, built, the one on the north side 227 f. long, on south side 440 f. long, **66**, ii, 9, iv, 85. Project and estimate of the company's engineer for completion of the work, dredging to 12 f. in cut and extension of north pier 373 f., of the south pier 196 f., **66**, iv, 85. Estimate, additional, for completion, $22,400, **66**, iv, 85.
To Aug., 1866, $68,100 spent by private enterprise, **66**, iv, 85.

**Surveys.**
Ordered by act of July 5, 1884, made under direction of Col. Barlow, **85**, 2005.
Examination by Maj. Raynolds, **66**, iv, 85, 86.

## LACROSSE, WIS. (See *Mississippi River.*)

## LAFOURCHE BAYOU, LA.[a]—(See *Donaldsonville to Rio Grande River, etc.*)

**Appropriations.**
1852, $2,500 (survey), act Aug. 30.
1878, 10,000, **78**, 85.
1879, 10,000, **79**, 107.
1880, [b]5,000, **80**, 1162.
1884, 5,000, **84**, 1281.
1888, 50,000, **88**, 1249.
1890, 50,000, **90**, 1745.
1892, 50,000, **92**, 1489.
1894, 40,000, **95**, 1752.
1896, 25,000, **96**, 1494.
1899, 7,500, **99**, 1842.

Total, 255,000

**Commerce.**
Commercial importance of the bayou, **74**, 766, 768; of country adjacent to the bayou, **74**, 768; **74**, 769.
List of obstructions, **74**, 767.
Importance of improvement, **80**, 1161; **84**, 1281.
Interests affected, **86**, 1269, 1274; **87**, 1366.
Increase in number of vessels following improvement, **88**, 1249.
Probable reduction of freight rates if slack-water navigation were to be adopted, **88**, 1249.
Description of; in 1894–95 most of it was carried in flatboats, but when steamboats were able to run through, the freight rates were much lower, **95**, 1751.
Commerce greatly benefited by improvements, **97**, 1758.

**Contracts.**
**1888.** J. H. Gardner, dredging, 43 cents per c. y., **89**, 1487.
**1895.** E. A. Burris, furnishing dredge, $64 per day, **95**, 1752.
**1896.** H. Camors, furnishing dredge, $49 per day, **96**, 1495.
**1897.** F. Beck, furnishing dredge to work 16 hours each day with two crews, $64.50 per 8 hours, **98**, 1470.
**1899.** J. K. Burriss, hire of dredge, $78 per day ($8,592), **1900**, 2250.

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[a] Examination.—Report (unfavorable) Oct. 8, 1845. Survey.—Report Feb. 12, 1853; estimate, $31,500. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] $500 to be applied to removal of pier at Donaldsonville, **81**, 387.

## LAFOURCHE BAYOU, LA.—Continued.

**1900.** J. J. Keegan, hire of dredge, $65 per day, **1900**, 2250.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **73**, 66; **74**, 74; **78**, 84; **79**, 107; **80**, 144; **81**, 196; **82**, 192; **83**, 211; **84**, 214, 216; **85**, 221; **86**, 219; **87**, 182, 188; **88**, 168; **89**, 196, 202; **90**, 177; **91**, 224; **92**, 217; **93**, 242; **94**, 223; **95**, 248; **96**, 217; **97**, 281; **98**, 272; **99**, 323; **1900**, 367.

ENGINEERS IN CHARGE:

Maj. C. W. Howell, 1873–81. Reports, **74**, 765; **78**, 613; **79**, 901; **80**, 1161; **81**, 1299.

Maj. A. Stickney, 1881–84. Reports, **82**, 1384; **83**, 1126; **84**, 1280, 1291.

Capt. T. Turtle, 1884–85. Report, **85**, 1408.

Maj. W. H. Heuer, 1885–87. Reports, **85**, 1408; **86**, 1266; **87**, 1365.

Capt. W. L. Fisk, 1888–91. Reports, **88**, 1248; **89**, 1485, 1531; **90**, 1742.

Maj. J. B. Quinn, 1891–99. Reports, **91**, 1821; **92**, 1487; **93**, 1814; **94**, 1356; **95**, 1750; **96**, 1493; **97**, 1757; **98**, 1468; **99**, 1842.

Maj. H. M. Adams, 1900–. Report, **1900**, 2249.

ASSISTANTS:

R. B. Talfor. Report, **74**, 766.

H. Stewart. Report, **84**, 1292.

Lt. O. T. Crosby, **85**, 1408. Report, **86**, 1267.

**Estimates.** (See *Plans and Projects.*)

By R. B. Talfor, for dredging and removal of snags, stumps, and wrecks, $100,100, **74**, 767.

**Operations.**

**1878–79.** Wrecking-flat built; 169 obstructions removed from the channel, **79**, 901.

**1879–80.** 827 snags, stumps, and logs, and 10 wrecks removed by hired labor, **80**, 1161.

**1880–81.** 771 snags, stumps, and logs removed by hired labor, **81**, 1299.

**1881–82.** 1,283 obstructions removed by hired labor, **82**, 1384.

**1882–83.** 487 obstructions removed by hired labor, **83**, 1126.

**1884–85.** Removal of obstructions by hired labor, **85**, 1408.

**1885–86.** Completion of survey ordered in 1882, **86**, 1266.

**1888–89.** Dredging and removal of obstructions resumed, **89**, 1487.

**1889–90.** 37,944 c. y. dredged; snags, and flat and steamboat wrecks removed from the channel, **90**, 1743.

**1890–91.** Dredging by hired labor, **91**, 1822.

**1891–92.** 95,984 c. y. dredged; 78 stumps and 10 wrecks removed from the channel, **92**, 1488.

**1892–93.** In connection with preceding year, about 117,000 c. y. dredged, and about 600 obstructions and 29 wrecks removed, **93**, 1815.

**1893–94.** About 86,000 c. y. dredged, some obstructions and 6 wrecks removed, **94**, 1357.

**1894–95.** About 117,000 c. y. dredged, 500 obstructions removed, and 16 wrecks also removed, **95**, 1751.

**1895–96.** 164,000 c. y. dredged, about 800 obstructions and 4 wrecks removed, **96**, 1494.

**1896–97.** About 135,000 c. y. dredged and some obstructions removed, **97**, 1758.

**1897–98.** 106,000 c. y. dredged and some obstructions removed, most of the work being done by contract, but some by Government dredge, **98**, 1469.

**1898–99.** 126,005 c. y. dredged and 199 obstructions, including the wrecks of several coal barges, removed, **99**, 1842.

**1899–1900.** Bars, wrecks, and other obstructions between Donaldsonville, La., and a point 8 miles below removed, **1900**, 2249.

**Physical characteristics.**

Causes of crevasses, **74**, 767.

Continued raising of levees necessary, **74**, 767, 769.

Action of floods in bayous, **86**, 1271.

High-water slopes, **86**, 1272.

Sediment, **86**, 1273.

Description of, **93**, 1814; **95**, 1751.

During eight months in the year, when the Mississippi is high, the bayou is navigable by the largest steamboats, but during extreme low water navigation is entirely suspended, even for flatboats drawing over 2 feet, **93**, 1814.

Subject to shoaling, which makes dredging slow and unsatisfactory, **93**, 1814; **94**, 1357; **95**, 1751.

**Plans.** (See *Estimates* and *Projects.*)

By R. B. Talfor, dredging and removal of snags, stumps, and wrecks, to give a 3-foot channel from Parrs Canal to Donaldsonville, **74**, 767. For the construction of a lock at the head of the bayou, and converting it into a tidewater canal, **74**, 768.

By Maj. Howell. 1. Construction of lock and dam at head of bayou. 2. See Projects, **74**, 769. Comparison of different plans, **74**, 769, 770.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Howell, 1879, relief of flood gorge by removing stumps and snags Thibodauxville to Parrs Canal, estimate $10,000, **74**, 769, 770. For dredging Upper Bayou to a depth of 4 feet, **79**, 901; **81**, 196.

By Capt. Turtle, 1884, continuation of

## LAFOURCHE BAYOU, LA.—Continued.

the project of 1879 from the point where work was suspended in 1883.

In 1889 operations were continued under Maj. Heuer's project of 1886 for the improvement of Bayou Lafourche by the construction of a lock at Donaldsonville to connect with the Mississippi River, converting the bayou into a salt-water canal, with dredging in the bayou so as to form a channel 5 f. deep and 75 f. wide; estimate $450,000, with annual cost of maintenance of $8,000, **86**, 1267, 1274, 1275; **87**, 1366; **92**, 1488.

By Maj. Quinn, 1896, modifying the project of 1886 for lock, etc., to provide for holding that project in suspension, and for restricting operations to maintenance by dredging; estimate $25,000 annually, **97**, 1758.

By Maj. Quinn, 1899, subproject to expend the appropriation of 1899 to maintain low-water navigation, with dredging, **99**, 1842.

Project further modified, 1900, to permit expending remaining money on dredging to maintain flatboat navigation during low water, **1900**, 2249.

**Surveys.**

By R. B. Talfor, 1873–74. Report, **74**, 766.

Ordered by act of Aug. 2, 1882, **84**, 216; made under direction of Capt. Stickney, 1883, **84**, 1291. Line of levels incomplete, **84**, 1292; completed, **86**, 1266, 1268.

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Fisk, **89**, 1531.

MAPS. **86**, 1268.

## LAGRANGE BAYOU. (See *Choctawhatchee River, Fla.; Holmes River, Fla.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1882, | [a] $2,000, | **83**, | 1000. |
| 1886, | 2,000, | **86**, | 1179. |
| 1888, | [b] 3,000, | **88**, | 1163. |
| 1890, | [c] 3,000, | **90**, | 1626. |
| Total, | [d] 10,000 | | |

**Commerce.**

Amount of, to be benefited by improvement, **82**, 1318.

Small, 1893, **93**, 1706.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 189; **82**, 185; **83**, 192; **84**, 201; **85**, 206; **86**, 204; **87**, 164; **88**, 152; **89**, 176; **90**, 158; **91**, 200; **92**, 196; **93**, 217; **99**, 295; **1900**, 336.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1881–85. Reports, **82**, 1318; **83**, 1000; **84**, 1192.

Capt. R. L. Hoxie, 1885–89. Reports, **85**, 1312; **86**, 1179; **87**, 1268; **88**, 1162.

Capt. P. M. Price, 1889–93. Reports, **89**, 1375; **90**, 1625; **91**, 1704; **92**, 1407; **93**, 1705.

Capt. C. A. F. Flagler, 1899–. Reports, **99**, 1666; **1900**, 2116.

ASSISTANTS:

H. Haines. Report, **82**, 1318.

J. E. Turtle. Report, **91**, 1705.

**Operations.**

**1883–84.** 208 snags, logs, and trees and 3,519 c. y. mud removed, **84**, 1192.

**1884–85.** Dredging and removal of obstructions continued, **85**, 1312.

**1890–91.** 2,671 overhanging trees cleared from the banks and 270 snags and logs removed from the banks, **91**, 1706.

**1889–1900.** Over 8,000 snags and other obstructions removed, **1900**, 2117.

**Physical characteristics.**

Description of, **89**, 1375; **90**, 1626; **99**, 1666.

**Plans.**

By Capt. Price, 1889, giving a 4½-f. navigation through Lagrange Bayou and clearing snags and logs from Holmes River; estimate, $15,222, **89**, 1375.

**Projects.**

By Maj. Damrell, 1881, improvement of the bayou by deepening the channel through it to the depth of 4½ f. existing through the "Narrows;" estimate, $19,944; **82**, 1318; **87**, 1268.

In 1891, after the expenditure of $10,000, Capt. Price recommended that no further appropriations be made until the necessities of commerce required it, **91**, 1705; **92**, 1408.

**Survey.**

Examination ordered by act of Mar. 3, 1881, made, 1881, under direction of Capt. Damrell, **82**, 1318.

Examination of Lagrange Bayou and Holmes River, ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Price, **89**, 1375.

## LAGUNA MADRE, TEX. (See *Brazos Santiago Harbor.*)

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[a] Part of $20,000, $18,000 of which was for Choctawhatchee River.

[b] Including Holmes River to Vernon.

[c] Continuing work on Holmes River.

[d] [illegible] of 1899 reappropriated $4,839.20, which had been returned to the Treasury, 99, 1667.

## LAKE BAYOU PIERRE, LA. (See *Red River.*)

## LAKE BISTENEAU, LA. (See *Bayou Loggy, Lake Bisteneau, and the Dorcheat, La.*)

## LAKE BURNSIDE. (See *Pearl River, Miss.*)

## LAKE CALUMET. (See *Calumet River to ——, Ill.*)

## LAKE CANNASANIER, LA. (See *Red River.*)

## LAKE CHAMPLAIN. (See *Gordons Landing, Vt.; North Hero Harbor, Vt.; Port Henry, N. Y.; Rouse Point, N. Y.*)

## LAKE CHAMPLAIN. (Channel between North and South Hero Islands.)[a]

**Appropriations.**

1836, $15,000, act July 4.
1837, 6,000, act Mar. 3.
1888, 10,000, **89**, 2445.

Total, 31,000

**Commerce.**

In 1897 two steamers carrying freight and passengers each passed through the channel daily during the season of navigation, **97**, 3299.

**Engineers.**

Chief of Engineers. Reports, **81**, 115; **82**, 116; **87**, 317; **88**, 287; **89**, 340; **90**, 307; **97**, 480; **98**, 128.

Engineers in Charge:

Maj. G. L. Gillespie. Report, **82**, 717.

Maj. M. B. Adams, 1887–89. Reports, **97**, 2412; **89**, 2444; **90**, 2876.

Maj. W. S. Stanton, 1897. Report, **97**, 3299.

Assistants:

D. White. Report, **82**, 718.

J. C. Churchill. Report, **87**, 2413.

**Operations.**

**1889–90**. 17,326 c. y. dredged, **90**, 2877.

**Physical characteristics.**

Description of, **82**, 717; **87**, 2413; **97**, 3299.

**Projects.**

By Maj. Gillespie, to widen the existing channel to 250 f. by dredging; estimate, $8,000, **82**, 718, 719.

By Maj. Adams, 1886, for the formation of a dredged channel 150 f. wide and 10 f. deep; estimate, $14,300, **87**, 2413.

**Surveys.**

Ordered by act of Mar. 3, 1881, and Senate resolution of Jan. 13, 1887, made under direction of Maj. Gillespie, **82**, 717. Also Maj. Adams, **87**, 2412.

Examination to ascertain character of obstructions said to exist, made, 1897, by Maj. Stanton, **97**, 3299.

## LAKE CHAMPLAIN, N. Y. AND VT. (Breakwaters.)

**Engineers.**

Chief of Engineers. Report, **93**, 419.

Engineer in Charge. Maj. M. B. Adams, 1893. Report, **93**, 3202.

Remarks on this report.—Capt. W. L. Marshall, **93**, 3209; Maj. E. H. Ruffner, **93**, 3209; Maj. Wm. Ludlow, **93**, 3210.

**Survey.**

In 1892 the Chief of Engineers, on the recommendation of the division engineer, called on Maj. Adams to prepare and submit a comprehensive report of his method of constructing breakwaters in Lake Champlain, which the division engineer thought might be followed to advantage in the construction of breakwaters on the Great Lakes, **93**, 3202.

Maps. **93**, 3208.

## LAKE CHAMPLAIN, N. Y. AND VT. (Narrows.)

**Appropriations.**

1886, $30,000, **87**, 2412.
1888, [b]15,000, **88**, 2103.
1892, 18,500, **92**, 2615.
1899, 5,000, **99**, 1292.

Total, 68,500

**Commerce.**

Description of, **85**, 2310.

**Contracts.**

**1886.** L. Whitney, rock removal at the Elbow, **87**, 2412. J. L. Johnson, dredging in Kinyons Bay, **87**, 2412.

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[a] Sometimes called the "Gut."

[b] From Benson to Whitehall.

## LAKE CHAMPLAIN, N. Y. AND VT. (Narrows)—Continued.

**1892.** Lynch & Hannan, dredging, 15 cents per c. y. ($13,800), **93**, 3201.

**1896.** Lynch & Hannan, removal of sunken logs and stumps, at 50 cents per c. y.; dredging, at 19½ cents per c. y. ($4,500), **96**, 3171.

**1899.** W. J. Daly, dredging, 20 cents per c. y., **1900**, 1486.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 357; **87**, 316; **88**, 289; **89**, 343; **90**, 309; **91**, 387; **92**, 365; **93**, 418; **94**, 392; **95**, 428; **96**, 384; **97**, 481; **98**, 130; **99**, 150; **1900**, 170.

ENGINEERS IN CHARGE:

Lt. Col. H. M. Robert. Report, **85**, 2310, 2314.

Maj. M. B. Adams, 1887–92. Reports, **87**, 2411; **88**, 2102; **89**, 2452; **90**, 2883; **91**, 2937; **92**, 2614.

Capt. S. S. Leach, 1893–96. Reports, **93**, 3201; **94**, 2499; **95**, 3241; **96**, 3170.

Maj. W. S. Stanton, 1897. Report, **97**, 3302.

Maj. A. M. Miller, 1898. Report, **98**, 1046.

Col. J. W. Barlow, 1899–. Reports, **99**, 1292; **1900**, 1485.

ASSISTANT. W. P. Judson. Report, **85**, 2312, 2315.

**Operations.**

**1886–87.** Rock removal at the Elbow and dredging in Kinyons Bay in progress, **87**, 2412.

**1887–88.** Dredging under contract continued, **88**, 2102.

**1888–89.** Dredging continued, **89**, 2453.

**1889–90.** Dredging continued, **90**, 2883.

**1893–94.** 89,818 c. y. dredged, **94**, 2499.

**1896–97.** 22,681 c. y. dredged, and 48 c. y. logs removed, **97**, 3302.

**1899–1900.** 40,020 c. y. dredged, **1900**, 1485.

**Physical Characteristics.**

Description of, **85**, 2312, 2315; **97**, 3302.

Channel subject to shoaling, **98**, 1046.

**Projects.**

By Lt. Col. Robert, 1885, formation of a channel 150 f. wide and 12 f. deep from the Elbow to Whitehall by dredging and rock removal, at an estimated cost of $30,000, **85**, 2312, 2313. Also the formation, by dredging, of a channel 200 f. wide and 12 f. deep from Four Channels to Bensons Landing, at an estimated cost of $50,000, **85**, 2315, 2318; **91**, 2937; **92**, 2614.

Maj. Miller estimated, 1898, the cost of completing the improvement would be $22,500, and that $5,000 would be required every 2 years for maintenance, **98**, 1046.

**Surveys.**

Ordered by act of July 5, 1884, made under the direction of Lt. Col. Robert, **85**, 2310, 2314.

Minor examinations, **96**, 3171; **97**, 3302.

MAPS:

In vicinity of Whitehall, **85**, 2312; **87**, 2411.

In vicinity of Four Channels, **85**, 2316.

## LAKE CITY, MINN. (Harbor of refuge). (See *Lake Pepin, Mississippi River.*)

## LAKE CONNECTICUT. (See *Connecticut River.*)

## LAKE ERIE TO OHIO RIVER. (Canal through the State of Ohio).

**Appropriations.**

| | | |
|---|---|---|
| 1894, | $20,000.00, | **96**, 368, 2973. |
| 1897 (claims), | 119.47, | act July 19. |
| Total, | 20,119.47 | |

**Commerce.**

Commercial consideration, **96**, 3035, 3065.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **96**, 368, 2973.

BOARD OF ENGINEERS. Convened by S. O. No. 43, 1894, at Detroit, Mich., on September 11, 1894, to make certain surveys, etc. (See *Surveys*). Report, **96**, 2976–3090. (Detailed index,[a] **96**, 2975.) (Lt. Col. A. Stickney, Majs. W. T. Stanton and W. L. Marshall.)

ASSISTANT. Capt. H. M. Chittenden. Report, **96**, 2996.

**Physical characteristics.**

Detailed description of the three routes considered available for continuous canals (see *Surveys*), eastern route, Cleveland to Marietta; central route, Sandusky Bay to Portsmouth; western route, Toledo to

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[a] Including, with other data, sources of information, historical sketch, comparison of the routes, advisability of constructing.

## LAKE ERIE TO OHIO RIVER (Canal through the State of Ohio).

Cincinnati, **96**, 2974, 3028; water supply, 3007.

**Projects.**

In 1896 the Board of Engineers estimated it would cost $12,311,472 to construct eastern route, $18.118,165 the central route, and $24,011,274 the western route, **96**, 2974, 3034.

**Surveys.**

Survey made 1825. (No estimate.) (H. Doc. 482, 55th Cong., 2d sess.

Survey of the Miami and Erie Canal, the Ohio Canal, and various branches as might be deemed available for the construction of a continuous canal, 70 f. at waterline and 7 f. deep, with new locks not less than 150 f. long and 21 f. wide, able to pass boats of at least 280 tons burden, to connect Lake Erie with the Ohio River through the State of Ohio, ordered by act of Aug. 17, 1894; report submitted by Board of Engineers in 1896 (see *Projects*), **96**, 2973. (Report unfavorable to canal of dimensions named by Congress; and, apart from an adequate improvement of the Ohio, construction of a canal not deemed advisable by the Board.)

## LAKE ERIE TO THE WABASH AND OHIO RIVERS (Ship canal).

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 229; **81**, 315.

ENGINEER IN CHARGE. Maj. J. M. Wilson. Report, **81**, 2348.

ASSISTANTS:
- B. Holley. Report, **81**, 2363.
- C. D. Ward. Report, **81**, 2400.
- W. S. Williams. Report, **81**, 2393.

**Plans.**

By Maj. Wilson, 1880, enlarging prism of existing canal Toledo to La Fayette, 216 miles, to a width of 70 f.; locks 110 f. long, 18 f. wide, and 7 f. over miter sill. Estimated cost, $24,236,135. **81**, 2352, 2354, 2362, 2393.

Enlarging existing canal Junction City to Cincinnati, to a width of 70 f., locks 110 f. long, 18 f. wide, and 7 f. over miter sill. Estimated cost, $23,440,275, **81**, 2356, 2358, 2363, 2400.

**Private (corporate) work.**

Description of Wabash and Erie Canal, **81**, 2349, 2413.

Of the Miami and Erie Canal, **81**, 2354, 2414.

**Survey.**

Ordered by act of June 14, 1880, **80**, 229; made under direction of Maj. Wilson, 1880, **81**, 2348.

MAPS. Of proposed routes, **81**, 2362.

## LAKE GEORGE, N. Y. (See *St. Johns River, Fla.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 343.

ENGINEER IN CHARGE. Maj. M. B. Adams, 1888. Report, **89**, 2454.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made 1888, under direction of Maj. Adams (report unfavorable), **89**, 2454.

## LAKE HURON. (See *Corsica Shoal.*)

## LAKE MICHIGAN. (See *Sturgeon Bay; Wabash River, Ill. and Ind.; Wabash River to.*)

## LAKE MICHIGAN CANAL. (See *Illinois River, Ill.*)

## LAKE MICHIGAN TO CALUMET RIVER (Canal).

**Engineers.**

CHIEF OF ENGINEERS. Report, **88**, 293.

ENGINEER IN CHARGE. Capt. W. L. Marshall, 1888. Report, **89**, 2154.

ASSISTANT. G. A. M. Liljencrantz. Report, **89**, 2156.

**Physical characteristics.**

Description of, **89**, 2156.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Marshall (report unfavorable, **89**, 2154.

## LAKE MICHIGAN TO STONEY LAKE, MICH. (Channel).

**Commerce.**
Description of interests that would probably be benefited. Probable commerce purely local. **1900**, 3940.

**Engineers.**
Chief of Engineers. Reports, **99**, 505; **1900**, 569.
Engineer in Charge. Capt. C. Harding, 1899–1900. Report, **1900**, 3939.
Assistant. L. W. Goddard. Report, **1900**, 3940.

**Physical characteristics.**
Description of; Stoney Lake, about 1½ miles long, east and west, and from 900 to 1,800 f. wide, with depths varying from 15 to 51 f. Its outlet into Lake Michigan is Stoney Creek, about ¼ mile long, sometimes closed at the mouth by sand drifts, **1900**, 3939.

**Survey.**
Examination of the channel from Lake Michigan to Stoney Lake ordered by act of Mar. 3, 1899, made 1899 under direction of Capt. Harding (report unfavorable), **1900**, 3939.

## LAKE MICHIGAN TO WABASH RIVER, IND. AND OHIO (Canal).

**Appropriation.**
1875 (survey), $2,000, act Mar. 3.

**Commerce.**
Importance of a commercial canal compared with the importance of a drainage canal, **76**, ii, 461–463.

**Engineers.**
Chief of Engineers. Report, **76**, 99.
Engineers in Charge:
Capt. H. Stansbury, 1831, **76**, ii, 455.
Maj. G. L. Gillespie, 1875. Report, **76**, ii, 454.
Assistant. G. Crocker. Report (extract), **76**, ii, 461.

**Physical characteristics.**
General description of Wabash and Kankakee rivers, **76**, ii, 454, 458, 461.

**Plans.**
By Capt. Stansbury, 1831, canal with 37 locks, 157 miles and 716 y. long, 40 f. wide at surface, 28 f. wide at bottom, 4 f. deep, and fed by waters from Devils Lake and Yellow River; estimate $2,000,000. Maj. Gillespie's estimate, $3,941,869.70. **76**, ii, 455, 456.
By Maj. Gillespie: (1) canal, via Trail Creek route, 118 miles and 213 y. long, with 44 locks, summit level of 5 miles in length and 170 f. above Lake Michigan, fed by the lakes north of La Porte, Ind.; estimate $3,446,479.02, **76**, ii, 457, 458, 459; (2) canal via Coffee Creek route, with a summit level, by a 30-f. cutting, 175 f. above Lake Michigan, requiring 17 locks, impracticability shown, **76**, ii, 459; (3) canal, via. Wolf Lake route, from Grand Calumet River, but having an inferior water supply, **76**, ii, 460; (4) canal via St. Joseph and Kankakee route, canal 148 miles and 1,062 y. in length, and requiring 32 locks; estimate $3,945,791.60, **76**, ii, 460, 461. Superiority of St. Joseph and Kankakee route, **76**, ii, 460, 461.

**Private (corporate) work.**
**1870–71.** Kankakee Valley Draining Company organized; considerable draining done, **76**, ii, 460, 462.

**Surveys.**
By Capt. Stansbury, 1831, **76**, ii, 455.
An examination under direction of Maj. Gillespie, 1875. Report, **76**, ii, 454.

## LAKE MUNROE. (See *St. Johns River, Fla.*)

## LAKE ONTARIO. (See *Black Creek Shoal; Chesapeake Bay to.*)

## LAKE PALMYRA, LA. AND MISS.

**Commerce.**
Small, **84**, 1371.

**Engineers.**
Chief of Engineers. Report, **84**, 227.
Engineer in Charge. Capt. A. M. Miller. Report, **84**, 1370.
Assistant. T. M. Farrell. Report, **84**, 1371.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under the direction of Capt. Miller (report unfavorable), **84**, 1370.

## LAKE PEPIN, WIS. (*See Mississippi River.*)

## LAKE PONTCHARTRAIN. (See *St. John Bayou.*)

## LAKE PONTCHARTRAIN, LA. (Harbor of refuge).

**Appropriation.**
1852, $25,000, act Aug. 30.

**Commerce.**
Important, **93**, 1843.

**Engineers.**
Chief of Engineers. Reports, **66**, 1, 7; **93**, 251.

Engineer in Charge. Maj. J. B. Quinn, 1892–93. Report, **93**, 1842.

**Physical characteristics.**
Description of, at entrance to canals running from the lake to New Orleans, the commerce on which is affected at times by storms at the entrance, **93**, 1842.

**Survey.**
Examination at or near the old and new basins ordered by act of July 13, 1892, made in that year by Maj. Quinn, (report favorable), **93**, 1842.

## LAKE PONTCHARTRAIN, LA. (Shoals at middle ground).

**Engineers.**
Chief of Engineers. Report, **91**, 221, 1839.

Engineer in Charge. Capt. W. L. Fisk, 1890. Report, **91**, 1839.

**Survey.**
Examination ordered by act of Sept. 19, 1890; made 1890, under direction of Capt. Fisk (report unfavorable), **91**, 1839.

## LAKE ST. CLAIR. (See *Swan Creek, Mich.*)

## LAKE ST. CROIX. (See *Hudson Harbor, Wis.*)

## LAKES HURON AND ERIE. (Channel to connect.)

**Engineers.**
Chief of Engineers. Report, **74**, 48.

Board of Engineers:
Considered excavating necessary, 1874, at four different points, viz: 1st, St. Clair Flats Ship Canal; 2d, Lake St. Clair; 3d, Detroit River at the Lime Kilns; 4th, mouth of Detroit River. Report, **74**, 213. (Majs. Comstock and Weitzel.)

**Plans.**
By Board of Engineers, 1874, dredging at St. Clair Flats Ship Canal, Lake St. Clair, and mouth of Detroit River; also blasting rock at Lime Kilns crossing, Detroit River; estimate, if partly in Canadian waters, $2,790,907; if wholly in American waters, $3,930,901, **74**, 214.

**Survey.**
A resolution of the House of Representatives Dec. 18, 1873, called for an approximate estimate of the expense of deepening and widening the navigable channels of the rivers and waters connecting these lakes for practical navigation for vessels drawing 20 f. of water, **74**, 48, 213.

## LAKE SUPERIOR. (See *Black River, Mich.; Iron River, Wis.; Portage Lake, Mich.; Port Wing, Wis.*)

## LAKE SUPERIOR TO MISSISSIPPI RIVER. (Canal.)

**Appropriation.**
1894, $10,000, **95**, 2588.

**Commerce.** (See *Projects.*)
Description of lake commerce at Duluth and of commerce on St. Croix River, **1900**, 3626.

**Engineers.**
Chief of Engineers. Reports, **95**, 353; **1900**, 521.

Engineer in Charge. Maj. C. B. Sears, 1895. Reports, **95**, 2587; **1900**, 3613.

Assistants:
Lt. C. H. McKinstry. Report, **96**, 2396, 2398.

J. Krey. Reports, St. Louis River route, **96**, 2443; Brule-St. Croix route, **96**, 2409, 2424; **1900**, 3616.

E. W. Lewis. Report, Nemadji-Kettle route, **96**, 2432.

Q. A. Thomas. Report, St. Louis River-Mississippi River route, **96**, 2438, 2442.

**Physical characteristics.**
Description of, **95**, 2588; **96**, 2393, 2396; **1900**, 3622.

The results obtained from examinations and explorations of the three designated routes justified making surveys of only two of these routes—via Allouez Bay, Brule and St. Croix rivers; via St. Louis, East Savannah, and Prairia rivers, and Sandy Lake, **96**, 2393, 2394.

In 1896 Maj. Sears considered route No. 1 (Brule-St. Croix) to be the most feasible, **96**, 2395.

*Brule-St. Croix route:* Preliminary re-

## LAKE SUPERIOR TO MISSISSIPPI RIVER. (Canal)—Cont'd.

port on, **96**, 2424; final report, **96**, 2409. Gauging, **96**, 2395, 2412, 2430. Distances, **96**, 2414. Rises to be overcome, **96**, 2415. Lockage from Lake Superior to Mississippi River, **96**, 2415. Available amount of water at the summit level, **96**, 2416. List of lands to be occupied by proposed canal and feeder, **96**, 2416. Approximate estimate of excavation, **96**, 2417. Description of characteristics of Allouez Bay and the Brule River, **96**, 2410; of Brule River Valley, **96**, 2411; of St. Croix River from the summit to the Mississippi, **96**, 2412. Approximate estimate for dams, **96**, 2420; for locks and lifts, **96**, 2421. Summary of data, **96**, 2423. List of prominent bench marks, **96**, 2424. List of dams in operation for logging purposes or otherwise along the route, **96**, 2431. List of dams selected for the storage of water or canalization purposes along the route, **96**, 2432.

*Nemadji-Kettle route:* Description of characteristics, **96**, 2432. Drainage areas, **96**, 2437. Gauging, **96**, 2437.

*St. Louis River-Mississippi route:* Description of, **96**, 2438, 2442, 2444. Gaugings, **96**, 2441. Surveys, **96**, 2442, 2443. Water power of the St. Louis River, **96**, 2445. Distances and elevations, **96**, 2446. Water supply for the summit, **96**, 2446. Estimated cost of acquisition of lands, **96**, 2447; of excavation, **96**, 2447. Approximate quantities and cost of dams, **96**, 2450; locks and lifts, **96**, 2452. List of prominent bench marks, **96**, 2454.

Summary of approximate data for routes proposed, **96**, 2398.

Length of the different routes, **96**, 2401. Lifts to be overcome by the different routes, **96**, 2402.

List of terminal harbors, **96**, 2402.

Water supply, **96**, 2402. Total amount of water required and available for the different routes, **96**, 2405. Water required for the summit and dependent levels of St. Louis-Mississippi route, **96**, 2405; Brule-St. Croix, **96**, 2406; Nemadji-Kettle, **96**, 2407.

Sectional dimensions of certain constructed and proposed canals of the world, **96**, 2409.

Comparison of some of the canals of the world, **1900**, 3627.

Comparison of rail and canal routes, **1900**, 3622.

**Projects.**

In 1896 Maj. Sears estimated it would cost $7,050,000 to construct a barge canal 80 f. wide at the water surface and 59 f. wide at the bottom, and 7 f. deep, along route No. 1, exclusive of the cost of compensation for the vested rights of the logging interests; $10,575,715 to construct a canal of similar dimensions along route No. 3, exclusive of compensation for the vested rights of water companies for the use of the water of the St. Louis River; and $18,015,112 to construct a steamboat canal along the same route 100 f. wide at bottom, 121 f. wide at water surface, and 7 f. deep. If the terminal for the waterway should be near St. Paul, route No. 3 would cost $19,000,000 more for barges and, if practicable, $30,000,000 for steamboats. **96**, 2394.

Maj. Sears reported, 1899, that canal costing about $7,000,000 was feasible, but that because of the proximity of many well-equipped railroad lines, and the great cost of canal transportation as compared with other methods, the construction of the canal not a public necessity, **1900**, 3614.

Approximate estimate of reimbursement of dam and water companies, **1900**, 3628.

**Surveys.**

Examinations and surveys for the location of a canal connecting Lake Superior with Mississippi River by three designated routes were ordered by act of Aug. 17, 1894, and were made under the direction of Maj. Sears, 1894–96 (see *Projects*), **95**, 2587; **96**, 2390.

Supplementary report called for by act of Mar. 3, 1899, made by Maj. Sears, 1899 (report not favorable to U. S. constructing canal) (see *Projects*), **1900**, 3613.

## LAKE SUPERIOR SHIP CANAL. (See *Keweenaw Bay, Mich.*)

## LAKE TRAVERSE, MINN. (See *Big Stone Lake and Lake Traverse, Minn.; Mississippi River.*)

## LAKE UNION. (See *Puget Sound.*)

## LAKE WASHINGTON. (See *Puget Sound.*)

## LAKE WEE TEE. (See *Wee Tee Lake, S. C.*)

## LAKE WINNEBAGO. (See *Calumet Harbor* and *Stockbridge Landing, Wis.*)

## LAKE WINIPISEOGEE, N. H.

**Appropriations.**
1880, $5,000, **80**, 340.
1881, 2,500, **81**, 494.

Total, 7,500

**Contracts.**
**1880–81.** Winipiseogee Lake Manufacturing Co., dredging, $1 per c. y., **81**, 495.

**Engineers.**
Chief of Engineers. Reports, **75**, 121; **79**, 52; **80**, 72; **81**, 71; **82**, 69; **83**, 64; **85**, 60.

Engineers in Charge:
Lt. Col. G. Thom, 1879–83. Reports, **75**, ii, 431; (Col.), **80**, 339, 362; **81**, 492; **82**, 501.
Col. C. E. Blunt, 1883–85. Reports, **83**, 423; **85**, 479.

**Operations.**
**1880–81.** 400 c. y. dredged, **81**, 494.
**1881–82.** 1,540 c. y. dredged, **81**, 494.
**1882–83.** 1,285 c. y. dredged, **83**, 424.

**Physical characteristics.**
Description of, **75**, ii, 431; **81**, 493.

**Plans.**
Of Lt. Col. Thom, 1875, buoying channel; estimate, $500, **75**, ii, 431, 432.

**Projects.**
By Col. Thom, 1879, channel 50 f. wide and 5 f. deep at extreme low water, through the outlet from Lake Winipiseogee to Long Bay. Estimate, $7,500. **80**, 363.

**Surveys.**
Examination for placing buoys, under direction of Lt. Col. Thom, 1875, **75**, 121, ii, 431.
Of outlet of Lake Winipiseogee ordered by act of March 3, 1879, made 1879, under direction of Col. Thom, **79**, 52; **80**, 362.
Examination of Winipiseogee Lake at "the Weirs" ordered by act of July 5, 1884, made, 1884, under direction of Col. Blunt. Report unfavorable. **85**, 479.
Maps. **80**, 362.

## LAKE WINNIBIGOSHISH (Experimental dam). (See *Mississippi River, reservoirs at head waters of.*)

## LAKE WORTH, FLA. (See *Indian River, Fla.*)

## LAMOILLE CANAL.[a]

## LAMPREY RIVER, N. H.

**Appropriations.**
1881, $10,000, **81**, 496.
1882, 10,000, **82**, 503.

Total, 20,000

**Commerce.**
Extent of prospective benefit to commerce, **75**, ii, 424; **81**, 495.

**Contract.**
**1882.** T. Symonds, dredging, 65 cents per c. y., **83**, 426.

**Engineers.**
Chief of Engineers. Reports, **75**, 121; **81**, 70; **82**, 69; **83**, 64; **84**, 73.

Engineers in Charge:
Lt. Col. G. Thom, 1881–83. Reports, **75**, ii, 424; (Col.), **81**, 495; **82**, 502.
Col. C. E. Blunt, 1883–84. Reports, **83**, 424; **84**, 472.

Assistant. S. Haagensen. Report, **75**, ii, 425.

**Operations.**
**1881–82.** 2,000 t. of bowlders removed, **82**, 503.
**1882–83.** 12,956 c. y. dredged and 330 c. y. bowlders removed, **83**, 425.

**Physical characteristics.**
Description, **75**, ii, 424, 425.

**Plans.**
By Lt. Col. Thom, 1875, cut through neck at Shackfords Point; estimate, $30,000; not recommended, **75**, ii, 424–426.

**Projects.**
By Col. Thom, 1874, improvement of the river, giving a channel with a depth of 12 f. at m. h. w. from its mouth up to the Lower Narrows, for a width of not less than 100 f., thence up to the New Market wharves, a depth of 11 f. at m. h. w., for a width of not less than 40 f.; estimate, $24,000, **75**, ii, 424–426; **81**, 495.

**Survey.**
By S. Haagensen, 1874, below New Market, N. H., **75**, 121, ii, 424, 425.

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[a] Surveys—Reports Feb. 18, 1829, and Jan. 27, 1829. (H. Doc. No. 482, 55th Cong., 2d session.

**L'ANGUILLE RIVER, ARK.**

**Appropriations.**
1878, $10,000, **79**, 115.
1879, 5,000, **79**, 115.
1880, 2,000, **80**, 1315.

Total, 17,000

**Commerce.**
Important, H. Doc. 57, 45th Cong., 3d sess., **79**, 969.
Demands of commerce do not require further appropriations, **82**, 215; **86**, 1389.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **79**, 115; **80**, 154; **81**, 217; **82**, 215; **83**, 222; **84**, 231; **85**, 251; **86**, 243; **87**, 209.
ENGINEERS IN CHARGE:
Maj. W. H. H. Benyaurd, 1878–81. Reports, H. Doc. 57, 45th Cong., 3d sess., **79**, 969; **80**, 1315; **81**, 1434.
Maj. T. H. Handbury, 1881–83. Reports, **81**, 1514; **82**, 1582; **83**, 1171.
Maj. M. B. Adams, 1883–84. Report, **84**, 1403.
Capt. H. S. Taber, 1884–87. Reports, **85**, 1600; **86**, 1388; **87**, 1543.

**Operations.**
Appropriation of 1878 applied to the purchase of a snag boat to be used upon L'Anguille, White, and St. Francis rivers, H. Doc. 57, 45th Cong., 3d sess., **79**, 969.
**1880–81.** Removing snags and overhanging trees, **81**, 1434.
**1881–82.** Removing snags and overhanging trees, **82**, 1582.
**1885–86.** Removing snags and trees, **86**, 1389.
**1886–87.** Removing snags and trees continued, **87**, 1544.

**Physical characteristics.**
Snags, logs, etc., obstruct navigation, H. Doc. 57, 45th Cong., 3d sess., **79**, 969.

**Project.**
By Maj. Benyaurd, removing snags, logs, and other obstructions with snag boat John R. Meigs; estimate $10,000, H. Doc. 57, 45th Cong., 3d sess., **79**, 969.
Accomplished in 1882 by the expenditure of about $14,000, and subsequent funds held for future contingencies, **85**, 1600.

**Survey.**
An examination of the river under the direction of Maj. Benyaurd, 1878. Report, H. Doc. 57, 45th Cong., 3d sess.

**LA PLAISANCE BAY, MICH.**[a] (See *Monroe Harbor, Mich.*)

**Appropriations.**
1826, $200.00, act May 20.
1827, 3,977.81, act Mar. 2.
1829, 2,318.00, act Mar. 3.
1832, 8,000.00, act July 3.
1834, 4,895.00, act June 28.
1836, 323.15, act July 2.

Total, 19,713.96

**Appropriations**—Continued.
Total by H. Doc. 120, 44th Cong., 1st sess., $19,603.07.

**Surveys.**
MAPS. Showing location of, **66**.

**LARCHMONT HARBOR, N. Y.**

**Appropriations.**
1890, $5,000, **91**, 801.
1899, 50,000, **99**, 1214.

Total, 55,000

**Contracts.**
**1890.** J. A. Bouker, delivering and placing riprap gneiss, $1.07 per t., **91**, 801.
**1899.** C. Frey, jr., riprap stone, 43 cents per s. t. ($44,720), **99**, 1215. J. P. Conkling, riprap stone, 51 cents per s. t. ($45,000). (Suit recommended for nonfulfillment of contracts.) **1900**, 1385, 1386.
**1900.** Anderson-Murphy Co., riprap stone, 54 cents per s. t. ($45,000), **1900**, 1386.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 71; **90**, 63; **91**, 74; **92**, 78; **93**, 85; **94**, 77; **95**, 87; **99**, 127; **1900**, 144.
ENGINEERS IN CHARGE:
Col. D. C. Houston, 1888–92. Reports, **90**, 675; **91**, 800; **92**, 704.
Lt. Col. H. M. Robert, 1893–95. Reports, **93**, 963; **94**, 686; (Col.), **95**, 821.
Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1213.
Maj. E. H. Ruffner, 1900–. Report, **1900**, 1383.
ASSISTANTS:
Lt. J. C. Sandford. Report, **90**, 676.
H. N. Babcock. Report, **90**, 678.

**Operations.**
**1890–91.** 4,119 t. of riprap deliv-

[a] Condition in 1866, dilapidated; of comparatively little use since the railroad terminus was abandoned, **66**, 30.

## LARCHMONT HARBOR, N. Y.—Continued.

ered, completing 74 l. f. of Umbrella breakwater, and 61 l. f. of Huron breakwater, **91**, 801.

**1899–1900.** 3,362 t. stone delivered, **1900**, 1385.

**Physical characteristics.**

Description of, **90**, 676; **91**, 800.

**Plans.**

By Col. Houston, 1889, improvement of the anchorage area of the harbor by removal of Umbrella and Huron rocks to 15 f. m. l. w.; estimate, $126,600, **90**, 678.

**Projects.**

By Col. Houston, 1890, improvement of the harbor entrance by construction of two riprap breakwaters extending from Umbrella and Huron rocks to the nearest shore; estimate, $105,000, **91**, 800; **92**, 705.

By Maj. Adams, 1899, building a breakwater southwardly 1,440 f. from the 6-foot curve off Long Beach Point, and for the removal of Huron Rock to a depth of 14 f. m. l. w.; estimate, $108,000, **99**, 1214.

**Survey.**

Ordered by act of Aug. 11, 1888, made, 1899, under direction of Col. Houston, **90**, 677.

## LA TRAPPE RIVER, MD.

**Appropriations.**

| | |
|---|---|
| 1892, | $2,500 |
| 1894, | 4,750 |
| Total, | 7,250 |

**Commerce.**

Satisfactorily provided for in 1896 by existing improvement, **97**, 1296.

**Contracts.**

**1892.** C. T. Caler, dredging, 10 cents per c. y., p. m., **93**, 1216.

**1894.** Baltimore Dredging Co., dredging, 15 cents per c. y., s. m., **95**, 1133.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 112; **91**, 132; **93**, 138; **94**, 126; **95**, 144; **96**, 131; **97**, 165, 171; **98**, 169; **99**, 194; **1900**, 222.

ENGINEER IN CHARGE. Maj. W. F. Smith, U. S. agent, 1888–. Reports, **89**, 920; **91**, 1215; **93**, 1215; **94**, 892; **95**, 1132; **96**, 962; **97**, 1276, 1295; **98**, 1161; **99**, 1386; **1900**, 1648.

ASSISTANT. A. Stierle. Reports, **89**, 920; **91**, 1215, 1217.

**Operations.**

**1892–93.** 20,000 c. y., p. m., dredged, **93**, 1215.

**1895–96.** 26,998 c. y., s. m., dredged, **96**, 962.

**Physical characteristics.**

Description of, **89**, 921; **91**, 1215.

**Plans.**

In 1889 Maj. Smith estimated the cost of dredging the desired channel at $13,000, **89**, 921.

**Projects.**

By Maj. Smith, 1892, channel 150 f. wide and 11 f. deep across the bar at the mouth, and for dredging the existing channel inside the river where needed to a width of 75 f. and a depth of 8 f. from the mouth to Trappe Landing; estimate, $7,250, **93**, 1215. Estimate was increased, 1896, to $9,750 on account of shoaling in the upper river since the last survey, **96**, 962.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Smith, **89**, 920.

Survey made, 1891, under direction of Maj. Smith, **91**, 1216.

Survey ordered by act of June 3, 1896. Report submitted by Maj. Smith in 1896 (report unfavorable. See *Commerce*), **97**, 1296.

## LAWRENCEBURG HARBOR, IND.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 285.

ENGINEER IN CHARGE. Lt. Col. W. E. Merrill. Report, **85**, 1839, 1840.

**Plans.**

By Lt. Col. Merrill, 1885, removing part of the projecting bar at the mouth of the Great Miami River. Estimate, $20,000. **85**, 1842.

**Survey.**

Ordered by act of July 5, 1884, made under direction of Lt. Col. Merrill, **85**, 1840.

**LEAF RIVER, MISS.**

**Appropriations.**
1890, $5,000, **91**, 1793.
1892, 5,000, **92**, 1458.
1894, 2,500, **95**, 1704.
1896, 2,500, **96**, 1453.
1899, 2,500, **99**, 1721.
Total, 17,500

**Commerce.**
Commerce to be affected by improvement, **89**, 1463.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **89**, 1462; **91**, 218; **92**, 211; **93**, 234; **94**, 216; **95**, 240; **96**, 212; **97**, 272; **98**, 266; **99**, 312; **1900**, 354.

ENGINEERS IN CHARGE:
Maj. A. N. Damrell, 1888–95. Reports, **89**, 1462; **91**, 1792; **92**, 1458; **93**, 1771; **94**, 1323; **95**, 1704.
Maj. W. T. Rossell, 1896–. Reports, **96**, 1453; **97**, 1697; **98**, 1442; **99**, 1721; **1900**, 2215.

**Operations.**
**1891–92.** 1,505 snags, stumps, and logs removed from the channel, and 2,156 overhanging trees cleared from the banks, **92**, 1458.
**1892–97.** About 2,300 obstructions removed from banks and stream in 1892–93, **93**, 1772; 13,000 in 1893–94, **94**, 1324; removal of obstructions in progress during the two following years, **95**, 1704; **96**, 1453; and about 5,600 removed in 1896–97, and project completed, **97**, 1697.
**1898–99.** About 2,400 snags and other obstructions removed from banks and channel of the river, **99**, 1721.
**1899–1900.** About 7,000 snags and other obstructions removed from banks and channel of the river, **1900**, 2215.

**Projects.**
By Maj. Damrell, 1889, improvement of the river from its mouth to the mouth of Bowie Creek by removal of snags, logs, overhanging trees, and similar obstructions, giving a high-water navigation for five months of the year, estimate, $25,000, **89**, 1462; **92**, 1458.
In 1893 Maj. Damrell estimated it would cost $1,500 annually for maintenance, **93**, 1772.

**Survey.**
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Damrell, **89**, 1462.

**LEAVENWORTH.** (See *Missouri River.*)

**LEECH LAKE, MINN.** (See *Mississippi River, reservoirs.*)

**LEES SLOUGH, FLA.** (See *Apalachicola River.*)

**LEIPSIC RIVER, DEL.**

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 138.
ENGINEER IN CHARGE. Lt. Col. G. Weitzel. Report, **84**, 854.
ASSISTANT. E. A. Giesler. Report, **84**, 854.

**Survey.**
Examination ordered by act of Aug. 2, 1884, made under direction of Lt. Col. Weitzel (report unfavorable), **84**, 854.

**LELAND HARBOR, MICH.**

**Commerce.**
Present requirements local, **70**, 149.
Ample natural harbors of refuge in the vicinity, **70**, 44, 149.

**Engineers.**
CHIEF OF ENGINEERS. Report, **70**, 44.
ENGINEER IN CHARGE. Capt. F. U. Farquhar, 1870. Report, **70**, 148.

**Estimates.** (See *Plans.*)
By Capt. Farquhar, for breakwater, $237,940.80, **70**, 149.

**Physical characteristics.**
General, of Leland Harbor and Carp River, **70**, 44, 149.

**Private (corporate) work.**
Bridge pier built at which vessels may lie during calm weather, **70**, 149.

**Plans.** (See *Estimates.*)
By Capt. Farquhar, breakwater 1,200 f. long, 34 f. wide, and 1,300 f. from shore, **70**, 149.

**LEMON CREEK, N. Y.** (See *Staten Island-New Jersey Channel.*)

**LEONARDTOWN HARBOR.** (See *Breton Bay, Md.*)

## LEVISA FORK. (See *Big Sandy River, Ky.*)

## LEWIS AND CLARK RIVER, OREG. (See *Young, Lewis and Clark rivers.*)

**Engineers.**

Chief of Engineers. Report, **91**, 421.

Engineer in Charge. Maj. T. H. Handbury, 1890–91. Report, **91**, 3383, 3384.

**Physical characteristics.**

Description of, **91**, 3383.

**Plans.**

By Maj. Handbury, 1891, removing sand bars, snags, and logs; estimate, $1,200, **91**, 3385.

**Survey.**

Survey ordered by act of Sept. 19, 1890, made, 1891, under direction of Maj. Handbury, **91**, 3385.

## LEWES, DEL. (Pier near.)

**Appropriations.**

| | | |
|---|---|---|
| 1870, | $225,000, | **70**, 72; **71**, 78, 665, 666. |
| 1874, | 10,000, | **74**, 90, ii, 130, 131. |
| 1875, | 40,000, | **75**, 96, ii, 173. |
| 1876, | 30,000, | **76**, 58, 267; **77**, 53, 257. |
| 1878, | 20,000, | **78**, 59, 434. |
| 1879, | 10,500, | **79**, 74, 450. |
| 1880, | 10,000, | **80**, 607. |
| 1881, | 10,000, | **81**, 816. |
| 1882, | 13,000, | **82**, 782. |
| 1890, | 10,000, | **90**, 889. |
| 1896, | 7,660, | **96**, 922. |
| Total, | 386,160 | |

**Commerce.**

Would probably be benefited by this work, **71**, 669, 672.

**Contracts.**

**1872.** Paulding, Kemble & Co., ironwork, **73**, 862.

**1873.** Macpherson, Willard & Co., ironwork, **73**, 862.

**1875.** Macpherson, Willard & Co., ironwork, **75**, ii, 177.

**1877.** Paulding, Kemble & Co., ironwork, **77**, 257.

**1878.** Patterson Iron Co., iron, **79**, 452.

**1881.** Eppinger & Russell, pine timber and creosoted piles, **81**, 818.

**1882.** Eppinger & Russell, pine timber, $27.25 and $31 per M, **82**, 782; **83**, 655.

Open-market agreements. **96**, 921.

**1897.** W. H. Virden, repairs to pier amounting to $6,722.39, **98**, 1094.

**Engineers.**

Chief of Engineers. Reports, **70**, 72; **71**, 77, 677, 678; **72**, 75, 761; **73**, 79; **74**, 90; **75**, 95; **76**, 58; **77**, 52; **78**, 59; **79**, 73; **80**, 96; **81**, 127; **82**, 124; **83**, 128; **84**, 137; **85**, 121; **86**, 118; **87**, 80; **88**, 81; **89**, 99; **90**, 89; **93**, 124; **94**, 113; **95**, 127; **96**, 115; **97**, 147; **98**, 150; **99**, 171; **1900**, 196.

Board of Engineers. Convened at Philadelphia, April 10, 1871, to consider Lt. Col. Kurtz's plan for pier. Approved plan for iron pier. Reconvened July 5; recommended approximate location. Report, **71**, 681–686. (Lt. Cols. Woodruff, Newton, and Kurtz.)

Engineers in Charge:

Lt. Col. C. S. Stewart, 1870; **70**, 70, 72.

Lt. Col. J. D. Kurtz, 1870–77; **70**, 70; **71**, 77. Reports, **71**, 662, 665, 667–676; **72**, 758; **73**, 859; **74**, ii, 130; **75**, ii, 173; **76**, 267; **77**, 255.

Col. J. N. Macomb, 1877–81. Reports, **78**, 431; **79**, 445; **80**, 605; **81**, 815.

Capt. W. Ludlow, 1881–82. Report, **82**, 781.

Lt. Col. G. Weitzel, 1882–84. Report, **83**, 654.

Lt. Col. T. L. Casey, jr., Mar. 19 to Apr. 19, 1884; **84**, 792.

Maj. W. H. Heuer, 1884–85. Report, **84**, 843.

Lt. Col. H. M. Robert, 1888–90. Reports, **85**, 845; **86**, 836; **87**, 804; **88**, 705; **89**, 869.

Maj. C. W. Raymond, 1890–. Reports, **90**, 888; **93**, 1170; **94**, 850; **95**, 1062; **96**, 920; **97**, 1213; (Lt. Col.), **98**, 1093; **99**, 1344; **1900**, 1574.

Assistants:

Capt. M. R. Brown, **71**, 77. Reports, **72**, 760; **73**, 860; **74**, ii, 131; **75**, ii, 173; **76**, 267.

Capt. W. Ludlow. Report, **81**, 818.

A. Stierle. Report, **82**, 782.

J. M. Stewart. Reports, **83**, 655; **84**, 844.

**Estimates.** (See *Projects.*)

By Lt. Col. Kurtz, pier, with wooden superstructure, $278,423.78; with iron superstructure, $328,227.38, **71**, 675, 676. Increased to $387,419.67; reasons for increase by $24,000, **74**, ii, 133, 134. Reasons for reducing $36,419.67, **75**, ii, 173; **76**, 267. For completion of work, $50,600, **71**, 53, 257.

By Col. Macomb, 1879, completion of existing project, $24,500, **79**, 450.

**Legislation.**

The State of Delaware gave site for

## LEWES, DEL.—Continued.

shore end of pier to the U. S., **72**, 75, 759.

Senate resolution of Mar. 12, 1886, directing an estimate to be made as to probable cost of an iron superstructure, **86**, 837.

By act of Mar. 3, 1891, Secretary of War was directed to assign to the Secretary of the Treasury a portion of the iron pier at Lewes, Del., for Marine-Hospital Service, whenever convenient to the War Department, **92**, 932.

**Operations.**[a]

**1871-72.** Completion of 231 l. f. of pier, **72**, 75, 759.

**1872-73.** Construction of 924 f. of pier and 1,050 f. of superstructure, **73**, 79, 860.

**1873-74.** Extension of superstructure 105 f.; total length cf pier 1,281 f., **74**, 90, ii, 130.

**1874-75.** Extension of superstructure 147 f.; repairs, **75**, 96, 175.

**1875-76.** Extension of pier 126 f.; total length, 1,533 f., **76**, 58, 267.

**1876-77.** Extension of superstructure 42 f.; total length, 1,460 f., **76**, 255.

**1877-78.** Extension of pier 126 f.; total length, 1,659 f., **78**, 59, 433.

**1878-79.** Extension of superstructure to the designed length, 1,701 f.; the 57th row of piles taken up for the purpose of lengthening them, **79**, 73, 448.

**1879-80.** Redriving iron piles in 57th row and placing of 52 sets of horizontal braces; superstructure replaced on part of pier, **80**, 605.

**1880-81.** 78 fender piles placed at pierhead and timber superstructure partly renewed, **81**, 1815.

**1881-82.** 107 fender piles placed and timber superstructure partly renewed, **82**, 783.

**1882-83.** Timber superstructure replaced over 500 l. f. of pier; iron rails purchased for railroad track for full length of pier, **83**, 655.

**1883-84.** Replacing timber superstructure in progress; railroad track laid for full length of pier, **84**, 844.

**1889-90.** Minor repairs made to pier, **90**, 888.

**1895-96.** Pier repaired at a total cost of $689.95, **96**, 921.

**1897-98.** Repairs costing $6,722.39 made to the pier, **98**, 1094.

**1898-99.** Storage platform built near head of pier, **99**, 1345.

**1899-1900.** Slight repairs made to pier, **1900**, 1575.

**Physical characteristics.**

Description, **72**, 75, 758, 762-777; **74**, ii, 131; **75**, ii, 175.

**Plans.**

History of plans and operations prior to the present work, **71**, 667, 668.

By Lt. Col. Robert, 1886, iron superstructure suitable for the requirements of the pier if subjected to railroad traffic. Estimate, $93,000 to $115,000, **86**, 838; **87**, 805.

**Private (corporate) work.**

Wooden pile pier 1,600 f. long, constructed by the Junction Breakwater Railroad Co., at a cost of $37,000, **71**, 669.

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Kurtz, 1871, landing-pier in Delaware Bay, near Lewes, Del., about 1,800 f. long, with floor 13 f. above m. l. w. From the shore end outward for a distance of 1,200 f. the pier to be 22 f. wide, and from thence to the outer end 43 f. wide; the superstructure to consist of iron screw piles from 22 to 45 f. long and 5¼ to 8 inches in diameter; the superstructure carrying the floor to be of wood. Estimate, $278,423.78, **71**, 670-680. Increased to $387,419.67, **74**, ii, 133, 134.

The substructure was completed in 1880, **80**, 606.

The total amount appropriated, $368,500, **86**, 837.

By Lt. Col. Robert, 1889, for repairing a 100-f. breach in the pier; estimated cost, $10,000, **90**, 888.

Employment of harbormaster and establishment of regulations governing use of the pier recommended, **94**, 851.

By Maj. Raymond, 1896, repair of the fender system and the substructure, **97**, 1213.

**Surveys.**

Under direction of Lt. Col. Kurtz, 1871, **72**, 75.

MAPS. Sketch showing soundings, **72**, 774. Sketch showing the method of driving screw piles, **79**, 448.

## LEWIS RIVER, WASH. (See *Youngs*, *Lewis*, etc.)

**Appropriation.**

1899, $10,000, **99**, 3248.

**Commerce.**

Description of, **95**, 3601; **97**, 3471, 3475.

In 1892 it amounted to 10,000 t. of freight and 14,000 passengers. There were large lumber shipments also, **93**, 3535.

In 1893 the annual commerce of the river was valued at $119,000, **95**, 3601.

In 1897 it was important and growing, **97**, 3471.

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[a] History of plans and operations, **71**, 667, 668, 672, 673. History of the work, **79**, 445.

## LEWIS RIVER, WASH.—Continued.

Large, 1900, in proportion to cost of annual maintenance of river, **1900**, 4365.

**Contract.**

**1899.** Cascade Construction Co., dredging 6,246 c. y., 25 cents, **1900**, 4364.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **83**, 342; **85**, 372; **93**, 458; **95**, 467; **97**. 523; **99**, 596; **1900**, 673.

ENGINEERS IN CHARGE:

Capt. C. F. Powell. Report, **84**, 2293.

Maj. W. A. Jones. Report, **85**, 2444.

Maj. T. H. Handbury, 1893. Report, **93**, 3533.

Maj. J. C. Post, 1895. Report, **95**, 3600.

Capt. H. Taylor, 1897. Reports, **97**, 3469, 3473.

Maj. Fisk, 1899. Report, **99**, 3248.

Capt. W. C. Langfitt, 1900; **1900**, 4345.

Capt. W. W. Harts (temporary charge), 1900. Report, **1900**, 4364.

ASSISTANTS:

Lt. H. Taylor. Report, **93**, 3535.

P. G. Eastwick. Report, **97**, 3476.

**Operations.**

**1899–1900.** 6,246 c. y. dredged; 5 brush and rock dams built; work in progress at the Cowley Bar Dike, the principal work, **1900**, 4364, 4365.

**Physical characteristics.**

Description of, **93**, 3534; **95**, 3601.

The river empties into the Columbia River 14 miles below the mouth of the Willamette River. A part of the river is divided into 2 forks, which are mountain streams.

Etna is at the mouth of Cedar Creek, and is about 12 miles from the mouth of Speliah Creek. Above and below the town there is a succession of bars and pools, the number diminishing downward. **93**, 3534.

Lacenter is situated on the east fork, 7 miles by water from the Columbia River. The average rise and fall of the tide at this place is 14 inches. **95**, 3601.

Duration of water elevations in 1896 at the forks and at Lacenter, **97**, 3477.

Freshets carrying considerable sediment damaging works, **1900**, 4364.

**Plans.**

In 1883 Capt. Powell considered a part of the river worthy of minor improvement, but that the work was not a public necessity, **84**, 2293.

In 1884 Maj. Jones considered the river worthy of improvement at an annual cost of $1,000 for the removal of snags, **85**, 2444.

**Projects.**

By Capt. Taylor, 1897, 6-f. channel in the main river to the forks, and a 4-f. channel thence to Lacenter on the east fork, by training dikes, closing dikes, and supplemental dredging; estimate, $20,460, **97**, 3475; **99**, 3248.

It was estimated, 1900, that $500 would be required annually for maintenance, **1900**, 4365.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Powell (see *Plans*), **84**, 2293.

Examination ordered by act of July 5, 1884, made under direction of Maj. Jones (see *Plans*), **85**, 2444.

Examination from its mouth to Speliah Creek, ordered by act of July 13, 1892, made under the direction of Maj. Handbury, 1892 (report favorable for limited improvement), **93**, 3533.

Examination from Lacenter to its mouth with a view to deepening the channel and improving navigation, ordered by act of Aug. 17, 1894, made, 1895, by Maj. Post (report favorable), **95**, 3600.

Examination of the north fork to Etna, ordered by act of June 3, 1896; report (favorable) submitted, 1896, by Capt. Taylor, **97**, 3469.

Survey of the river from the Columbia River to Lacenter, ordered by act of June 3, 1896, made, 1897, by direction of Capt. Taylor (see *Projects*), **97**, 3473.

## LEXINGTON, MO. (See *Missouri River between mouth and Sioux City.*)

## LEXINGTON HARBOR, MICH.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 319.

ENGINEERS IN CHARGE. Col. O. M. Poe, 1888. Report, **89**, 2281.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Col. Poe (report unfavorable), **89**, 2281.

## LICKING RIVER, KY.

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $3,000, | **89**, 1983. |
| 1890, | 3,000, | **90**, 2273. |
| 1899, | 10,000, | **1900**, 3155 (survey). |
| Total, | 16,000 | |

**Commerce.**

Important, **72**, 424, 425; **79**, 1422.

Utility as a harbor of refuge from ice questioned, **72**, 425.

Damage sustained from ice floes of Licking River in 1856, **72**, 421, 424.

## LICKING RIVER, KY.—Continued.

Description of. Mostly lumber. Unimportant. **93**, 2646; **95**, 2516.

**Engineers.**

Chief of Engineers. Reports, **71**, 60; **72**, 57; **78**, 109; **79**, 147; **81**, 265; **82**, 260; **85**, 285; **87**, 249; **88**, 227; **89**, 264; **90**, 238; **91**, 306; **92**, 292; **93**, 332, 335; **94**, 304, 343; **95**, 340; **1900**, 476.

Engineers in Charge:

Sylvester Welch, chief State engineer, 1836–37. Report, **79**, 1432.

Maj. W. E. Merrill, 1871–79. Reports, **71**, 392; **72**, 420; **79**, 1422.

Maj. J. W. Cuyler. Report, **82**, 1964.

Lt. Col. W. E. Merrill. Report, **85**, 1843.

Maj. J. C. Post. Report, **87**, 1902.

Maj. D. W. Lockwood, 1889–99. Reports **89**, 1983; **90**, 2273; **91**, 2462; **92**, 2097; **93**, 2630, 2644; **94**, 1992; **95**, 2498, 2513.

Maj. W. H. Bixby, 1900. Report, **1900**, 3155.

Assistants:

N. B. Buford, assistant State engineer, 1836–37. Report, **79**, 1434.

C. Schenk. Reports, **79**, 1423; **1900**, 3163.

B. F. Thomas. Reports, **90**, 2274; **91**, 2462.

**Legislation.**

Act of general assembly of Kentucky incorporating the "Licking River Lumber & Mining Co.," stating privileges, etc., **79**, 1436. Amendment, **79**, 1437.

**Operations.**

**1888–89.** 133 snags removed from channel and 25 trees from the banks, **89**, 1983.

**1889–90.** 236 trees, 430 snags, 324 stumps, 4,679 c. y. solid rock, and 4,172 c. y. loose rock removed, **90**, 2273.

**1890–91.** 5,875 c. y. solid and 2,145 c. y. loose rock and 80 snags removed from the channel, **91**, 2462.

**1891–92.** 911 snags, trees, and stumps, 798 c. y. loose rock, and 2,001 c. y. solid rock removed, **92**, 2097.

**Physical characteristics.**

General, **72**, 420, 421; **79**, 1422, 1424, 1426, 1435; **93**, 2645; **95**, 2514; **1900**, 3159, 3164.

Rise and fall of river and tributaries, **79**, 1425, 1426, 1430.

Coal and iron mines; quarries in vicinity, **79**, 1427–1429, 1431.

The river lies wholly in the State of Kentucky, empties into the Ohio, with uncertain water supply, and parts of it are narrow and tortuous in the upper part. It has been surveyed for a distance of 297 miles from its mouth, **93**, 2645, 2646.

Water supply irregular, **95**, 2515.

The entire drainage basin of the Licking River is about 4,925 square miles, **1900**, 3159.

Gauge readings, **1900**, 3181.

Under the project of 1888 the river not susceptible of permanent improvement. Each high water producing a large number of snags and other obstructions, **93**, 2631; **94**, 1992; **95**, 2498.

**Plans.**

By Maj. Merrill, harbor of refuge from ice floes, at Newport, Ky. (mouth of Licking River), by constructing a lateral basin, having an area of from 5.8 to 11.2 acres, according to various plans; and for the excavation of a channel through the rock bar at the mouth of Licking River, to a depth of 4 or 6 f., and with either a straight or curved channel, at a total estimated cost ranging in amount from $518,513 to $1,624,794, **72**, 423, 424, 425.

By Sylvester Welch, 1837, constructing locks and dams, for slack-water navigation from the mouth to West Liberty, at estimated costs ranging from $1,539,591 to $2,036,000, **79**, 1433, 1434.

By Maj. Merrill, constructing locks and dams to improve the navigation of Licking River from its mouth to the confluence with Elk Fork, at an estimated cost of $2,002,947. For slack-water navigation from the mouth to Slate Creek, estimate, $1,424,184, **79**, 1423.

In 1882 Maj. Cuyler considered that the radical improvement could only be accomplished by locks and dams at an estimated cost of $684,000, **82**, 1965.

By Lt. Col. Merrill, 1885, connection of navigation of the Licking with that of the Ohio River by the removal of the bar at the mouth of the former; estimate, $75,000, **85**, 1844.

By Maj. Post, 1887, improvement, extending from Farmers to West Liberty, by removal of snags and similar obstructions; estimate, $17,680; **87**, 1903.

**Private (State) Work.**

**1837–42.** State of Kentucky undertook the construction of locks and dams for the improvement of the river at a useless expenditure of $372,520. The work was stopped before completion, **72**, 421; **79**, 1423, 1431.

**1837.** Channel 100 f. wide and 1,250 f. long excavated through the rock bar at the mouth of Licking River, at a cost of $5,383.47, **79**, 1431.

**1868.** Commission appointed by State of Kentucky to ascertain cost of removing the milldams and other obstructions, **79**, 1432.

Description of work done before acquirement of control by the United States, **93**, 2645; **95**, 2514.

## LICKING RIVER, KY.—Continued.

**Projects.**

By Maj. Post, 1887, improvement extending from Farmers to West Liberty by removal of snags and similar obstructions; estimate, $17,680, **87**, 1903.

Maj. Bixby estimated, 1900, it would cost $3,475,000 to obtain 6-f. navigation up to Falmouth, and $47,000 annually for maintenance; and $270,000 or $307,000 for lock and dam at or near Three-Mile Ripple, but such work not recommended; and for removal of Three-Mile Ripple and adjoining shoals, $100,000, recommended, **1900**, 3156.

**Surveys.**

By Lts. Turnbull and Grayson, 1829, **72**, 420; **79**, 1422, 1423.

By N. B. Buford, 1837, under direction of S. Welch, chief State engineer. Reports, **79**, 1432, 1434.

Under direction of Maj. Merrill, 1871, a survey of the mouth of Licking River to ascertain its adaptability for an ice harbor. Report, **72**, 420.

By C. Schenk, 1878, of the river in general. Report, **79**, 1423.

Examination ordered by act of June 14, 1880, made under the direction of Maj. Cuyler, **82**, 1964.

Previous surveys, **82**, 1964.

Of bar at mouth of the river ordered by act of July 5, 1884, made under direction of Lt. Col. Merrill, **85**, 1843.

From Farmers to West Liberty ordered by act of Aug. 5, 1886, made under direction of Maj. Post, **87**, 1902.

Examination of the river with a view to providing slack-water navigation ordered by act of July 13, 1892, made in the same year by Maj. Lockwood (report unfavorable), **93**, 2644.

Examination of the mouth ordered by act of Aug. 17, 1894, with a view to the construction of an ice harbor, including a lock and dam, made in that year by Maj. Lockwood (report unfavorable), **95**, 2513.

Survey of Licking River, Ky., from its mouth, opposite Cincinnati, Ohio, to Falmouth, Ky., with a view to its improvement, including estimate of cost of a lock and dam at or near Three-Mile Ripple, about 3 miles above its mouth, ordered by act of Mar. 3, 1899, made, 1900, under direction of Maj. Bixby (see *Projects*), **1900**, 3156.

## LILLINGTON RIVER, N. C.

**Appropriations.**

1881, $3,000, **81**, 1021.
1882, 3,000, **82**, 1101.

Total, 6,000

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 165; **82**, 160; **83**, 168; **84**, 173.

ENGINEERS IN CHARGE:

Capt. C. B. Phillips, 1880–82. Reports, **81**, 1020, 1021.

Capt. J. Mercur, 1882–84. Reports, **82**, 1101; **83**, 860.

Capt. F. A. Hinman, 1884. Report, **84**, 1044.

ASSISTANTS:

J. P. Darling. Report, **81**, 1022.

W. H. James. Reports, **83**, 861; **84**, 1044.

**Operations.**

**1882–83.** River cleaned of snags and obstructions from mouth to Lillington; cut-off dredged, **83**, 861.

**1883–84.** Dredging of cut-offs completed to a depth of from 6 to 10 f. at low water; projecting points cut-off and a small island removed; completing improvement purposed, **84**, 1044.

**Projects.**

By Capt. Phillips, 1881, removing snags, logs, and trees, mouth to Lillington, 11 miles, and three projecting points of land, and by dredging cut-offs to give navigable depth of 5 f. Estimated cost, $6,003, **81**, 1022. Completed in 1884, **84**, 1044.

**Surveys.**

Ordered by act of June 14, 1880, made, 1881, under direction of Capt. Phillips, **81**, 1020.

MAPS. **83**, 860.

## LIMESTONE CREEK, KY.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 244.

ENGINEER IN CHARGE. Lt. Col. W. E. Merrill, 1887. Report, **87**, 1834.

ASSISTANT. Lt. L. H. Beach. Report **87**, 1834.

**Survey.**

Examination of bar at mouth ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. Merrill (report unfavorable), **87**, 1834.

## LINCHESTER RIVER, MD.

**Engineers.**
CHIEF OF ENGINEERS. Report, **91**, 131, 1202.
ENGINEER IN CHARGE. Maj. W. F. Smith, U. S. agent, 1891. Report, **91**, 1203.
ASSISTANT. A. Stierle. Report, **91**, 1203.

**Physical characteristics.**
Description of, **91**, 1203.

**Survey.**
Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Smith (report unfavorable), **91**, 1203.

## LINCOLNVILLE HARBOR, ME.

**Commerce.**
Benefit of improvement to commerce, **79**, 277, 278.
Description of, **93**, 728.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 46; **79**, 52; **93**, 37.
ENGINEER IN CHARGE:
Lt. Col. Thom, **78**, 46; **79**, 52. Report, **79**, 275.
Lt. Col. P. C. Hains, 1892–93. Report, **93**, 727.
ASSISTANT. A. C. Both, **79**, 275. Report, **79**, 276.

**Physical characteristics.**
Description of, **79**, 275, 276, 277; **93**, 727.
Table of tides, **79**, 276.

**Plans.**
Of Lt. Col. Thom, 1879, channel 1,900 f. long, 50 to 80 f. wide, and 3 f. deep, with a basin at its upper end 250 f. by 110 f.; also a breakwater to protect entrance; estimate, $10,000, **79**, 275, 276, 277.

**Surveys.**
Ordered and in progress, 1878, **78**, 46.
Completed by A. C. Both, **79**, 52, 275.
Examination ordered by act of July 13, 1892, made by Lt. Col. Hains, 1892 (report unfavorable), **93**, 728.

**LINK HORN BAY.** (See *Broad Bay; Lynn Haven Bay, Va.*)

## LINK RIVER, OREG.

**Engineers.**
CHIEF OF ENGINEERS. Report, **88**, 304.
ENGINEER IN CHARGE. Capt. C. F. Powell, 1887. Report, **88**, 2179.

**Physical characteristics.**
Description of, **88**, 2179.

**Survey.**
Examination ordered by act of Aug. 5, 1886, **87**, 330; made, 1887, under direction of Capt. Powell (report unfavorable), **88**, 2179.

## LISTONS TREE POINT, DELAWARE RIVER. (See *Delaware River.*)

**Engineers.**
CHIEF OF ENGINEERS. Reports, **67**, 43; **68**, 63.
ENGINEER IN CHARGE. Lt. Col. C. S. Stewart. Reports, **67**, 440; **68**, 703, 706.
ASSISTANT. R. M. Bache, **68**, 703, 706.

**Estimates.** (See *Plans.*)
By Lt. Col. Stewart, survey, $1,000; ice harbor, $480,000, **68**, 708.

**Expenditures.**
For survey, $1,277.01, **68**, 707.

**Plans.** (See *Estimates.*)
By Lt. Col. Stewart, ice harbor, consisting of 21 large and 2 small piers, **68**, 706, 708.

**Survey.**
Under direction of Lt. Col. Stewart, by R. M. Bache, U. S. C. S., 1867. Reports, **67**, 440; **68**, 703, 706, 708.

**LITTLE BAY DE NOQUETTE.** (See *Whitefish River, Mich.*)

## LITTLE CAILLOU BAYOU, LA.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 197; **82**, 193.

ENGINEER IN CHARGE. Maj. A. Stickney. Report, **82**, 1412.

ASSISTANT. H. S. Douglass. Report, **82**, 1413.

**Physical characteristics.**

Description of, **82**, 1413.

**Plans.**

By Maj. Stickney, 1882, widening, the dredged channel from Boudro's Canal to 24 miles above that point, for a further distance of 4 miles, 4 f. deep and 30 f. wide together with removing of obstructions; estimate, $7,392, **82**, 1414.

**Survey.**

Ordered by act of June 14, 1880, **80**, 146; made under direction of Maj. Stickney; 1882, **82**, 1412.

## LITTLE CALUMET RIVER, ILL. (See *Calumet River.*)

## LITTLE CHAIN. (See *Mississippi River.*)

## LITTLE COMPTON, R. I. (See *Churches Cove.*)

## LITTLE CREEK, DEL.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 98; **81**, 129.

ENGINEER IN CHARGE. Col. J. N. Macomb. Report, **80**, 829.

ASSISTANT. W. S. Edwards. Report, **80**, 829.

**Plans.**

By Col. Macomb, 1880, channel mouth to Little Creek Landing, 3½ miles, 6 f. deep and 40 f. wide, with four short canals across sharp bends in the creek. Estimate, $17,200. **81**, 830.

**Survey.**

Ordered by act of June 14, 1880, made, 1880, under direction of Col. Macomb, **80**, 829.

## LITTLE DEALS ISLAND, MD. (See *Deals Island.*)

## LITTLE EGG HARBOR BAY AND INLET, INCLUDING GREAT BAY, N. J. (Harbor of refuge.)

**Engineers.**

CHIEF OF ENGINEERS. Report, **91**, 118.

ENGINEER IN CHARGE. Maj. C. W. Raymond, 1890. Report, **91**, 1095.

**Physical characteristics.**

Description of, **91**, 1095.

**Survey.**

Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Maj. Raymond (report unfavorable), **91**, 1096.

## LITTLE EGG HARBOR, N. J.

**Appropriations.**

1836, $5,000, act July 4.  
1838, 10,000, act July 7.  
1852, 8,500, act Aug. 30.

Total, 23,500

**Engineers.**

CHIEF OF ENGINEERS. Report, **66**, 37.

ENGINEER IN CHARGE. Col. J. D. Graham, **66**, 37.

**Project.**

For repairing the public works at Little Egg Harbor, **66**, 37.

## LITTLE HARBOR AT PORTSMOUTH, N. H. (See *Portsmouth Harbor, N. H.*)

**Appropriations.**

1886, $10,000, **86**, 60.  
1888, 20,000, **88**, 398.  
1890, 40,000, **90**, 454.  
1892, 30,000, **92**, 532.  
1894, 10,000, **95**, 577.

**Appropriations**—Continued.

1896, 10,000, **96**, 580.  
1899, 12,000; **99**, 1047.

Total, 132,000

## LITTLE HARBOR AT PORTSMOUTH, N. H.—Continued.

**Commerce.**

No commerce. Work intended as a harbor of refuge, **85**, 483; **87**, 469; **93**, 720.

List of vessels wrecked near Little Harbor between 1879 and 1889, **89**, 545.

**Contracts.**

**1887.** Moore & Wright, dredging, 24 cents per c. y., **87**, 468.

**1888.** New England Dredging Co., dredging, 28 cents per c. y., **89**, 545.

**1890.** T. A. Rowe, stone delivered in breakwater, 69 cents per t., and construction of beacon, $450, **91**, 609.

**1892.** G. W. Andrews, breakwater construction; stone, $1.11 per t., **92**, 533.

**1893.** Moore & Wright, dredging, 19 cents per c. y., s. m. ($28,500), **93**, 721.

**1894.** Wm. S. White, breakwater construction; stone, $1.96 per t. ($12,212.76), **94**, 528.

**1895.** A R. Wright, dredging, 16 cents per c. y , s. m. ($12,800), **95**, 577.

**1897.** C. H. Souther, dredging, 14⅞ cents per c. y., s. m. ($8,925), **97**, 797.

G. W. Andrews, repairs to breakwater, replacing coping stone, $200 for the job; $1.85 per t. for stone ($2,050), **98**, 837.

**1900.** C. H. Souther, dredging, 16⅞ cents per c. y., s. m. (64,000 c. y.), **1900**, 1152.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **85**, 60, 480; **86**, 59; **87**, 21; **88**, 21; **89**, 30; **90**, 25; **91**, 31; **92**, 38; **93**, 36; **94**, 35; **95**, 37; **96**, 40; **97**, 41; **98**, 51; **99**, 60; **1900**, 68.

ENGINEERS IN CHARGE:

Col. G. Thom. Report, **82**, 507.

Col. C. E. Blunt. Report, **85**, 480.

Lt. Col. J. A. Smith, 1886–92. Reports, **87**, 468; **88**, 397; **89**, 543; **90**, 454; **91**, 608.

Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 531; **93**, 719; **94**, 527.

Lt. Col. D. P. Heap, 1895. Report, **95**, 575.

Lt. Col. A. N. Damrell, 1896. Report, **96**, 579.

Maj. R. L. Hoxie, 1897–98. Reports, **97**, 796; **98**, 837.

Maj. S. W. Roessler, 1899. Report, **99**, 1047.

Maj. W. L. Fisk, 1900. Report, **1900**, 1151.

**Operations.**

**1886–88.** 36,021 c. y. dredged from cut, **87**, 468; **88**, 398.

**1888–89.** 37,479 c. y. dredged, **89**, 544.

**1889–90.** 27,000 c. y. dredged, **90**, 454.

**1890–91.** Beacon built, and 4,543 t. stone placed in breakwater, **91**, 609.

**1891–92.** 13,502 t. stone placed in breakwater, **92**, 532.

**1892–93.** 6,096 t. stone placed in breakwater and about 47,500 c. y. dredged, **93**, 720.

**1893–94.** About 9,000 t. stone placed in breakwater and about 98,000 c. y. dredged, **94**, 528.

**1894–96.** 62,500 c. y. dredged, **95**, 576; **96**, 580.

**1896–97.** 4,829 c. y. dredged, **97**, 796.

**1897–98.** About 47,000 c. y. dredged, **98**, 837.

**1898–99.** 1,058 t. stone placed to repair breakwater, **99**, 1047.

**1899–1900.** 25,735 c. y. dredged, **1900**, 1151.

**Plans.**

By Col. Blunt, conversion of Little Harbor into a larger harbor of refuge by extending area and construction of 2 breakwaters. Estimate, $154,000. **85**, 481.

By Maj. Smith, 1886, for an enlarged harbor. Estimate, $165,000, **87**, 470.

**Projects.**

By Col. Thom, 1882, dredging a channel of entrance to the inner harbor 9 f. deep at m. l. w. and 100 f. wide, widening the anchorage basin to 300 f. for a distance of 700 f., and giving additional protection by a small breakwater on the ledge at Jerry Point. Estimate, $33,000. **82**, 507; **85**, 481; **86**, 60; **87**, 468.

Project enlarged by Lt. Col. Smith, 1888, to provide for 2 small breakwaters at the mouth of the harbor, and for dredging the channel and anchorage basin to a depth of 12 f. at low water. Estimate, $235,000. **88**, 397; **89**, 30, 543, 544; **92**, 531.

Project amended so as to reduce the area to be dredged from 49 to 40 acres, making estimated cost, $145,000, **95**, 576.

**Survey.**

Survey with a view to its improvement for a harbor of refuge ordered by act of July 5, 1884, made under direction of Col. Blunt, **85**, 480.

MAPS. **87**, 470.

## LITTLE KANAWHA RIVER, W. VA.

**Appropriations.**

| | | |
|---|---|---|
| 1876, | $7,300, | **77**, 94, 663, 665. |
| 1878, | 18,000, | **78**, 108, 810, 813. |
| 1879, | 18,000, | **79**, 145, 1347. |
| 1880, | 15,000, | **80**, 1833. |
| 1881, | 40,000, | **81**, 1990. |
| 1882, | 31,000, | **82**, 1958. |
| 1886, | 16,875, | **86**, 1624. |
| 1888, | 25,000, | **88**, 1793. |
| 1890, | 40,000, | **90**, 2278. |
| 1896, | 1,500, | **96**, 2328. |
| 1899, | 743, | **99**, 2474. |
| Total, | 213,418 | |

**Commerce.**

Probable commerce of river, **75**, 743.

Navigation only during high water, **75**, 744.

Commerce of 1877 passing lock of Little Kanawha Navigation Co., **77**, 664.

Tolls collected by Little Kanawha Navigation Co. for 1881, **81**, 1990.

Country rich in resources, 1894, **95**, 2523.

Not largely increased by river improvement, **96**, 2328; **99**, 426.

**Contracts.**

**1877.** Removal of rock at Beaver Rocks and Nailor Bend, **77**, 663.

**1882.** T. B. Townsend, dimension and rubble stone, $4.50 and $3.50 per c. y., **82**, 1959.

**1885.** Portsmouth Foundry & Machine Works, boilers and machinery for lock construction, **85**, 1891. S. M. Hamilton & Co., cement, $1.40 per bbl. A. J. Mitchell, sawed lumber, **85**, 1891; timber, **85**, 1891. Morris & Co., coal, 8½ cents per bushel, **85**, 1891.

**1891.** T. W. Moore, oak timber, $6,332, **91**, 2472. Pattin, Hall & Pattin, ironwork, $2,118, **91**, 2472. G. Kinsey & Co., ironwork, $684.95, **91**, 2472.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **75**, 73; **77**, 94; **78**, 107; **79**, 145; **80**, 197; **81**, 265; **82**, 259; **83**, 267; **84**, 266; **85**, 291; **86**, 285; **87**, 242; **88**, 228; **89**, 266; **90**, 240; **91**, 308; **92**, 295; **93**, 334; **94**, 307; **95**, 342, 343; **96**, 299; **97**, 384; **98**, 362; **99**, 425; **1900**, 489.

ENGINEERS IN CHARGE:

Maj. W. E. Merrill, 1875–79; **75**, 73. Reports, **75**, 740; **77**, 663; **78**, 806, 813; **79**, 1346.

Maj. J. W. Cuyler, 1880–83. Reports, **80**, 1831; **81**, 1988; **82**, 1957.

Capt. J. C. Post, 1883–87. Reports, **83**, 1572; **84**, 1754; **85**, 1890; **86**, 1623.

Lt. Col. W. E. Merrill, 1887. Report, **87**, 1828.

Maj. D. W. Lockwood, 1888–95. Reports, **88**, 1792; **89**, 1987; **90**, 2278; **91**, 2471; **92**, 2114, 2117; **93**, 2641; **94**, 2006; **95**, 2510, 2520.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2327; **97**, 2582.

Maj. W. H. Bixby, 1898–99. Report, **98**, 2113.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2474; **1900**, 3317.

ASSISTANTS:

J. E. Carpenter. Report, **75**, 742.

J. E. Bell, **77**, 663. Report, **78**, 807.

W. E. Strong. Reports, **79**, 1346; **80**, 1833.

M. W. Venable. Report, **87**, 1830.

B. F. Thomas. Reports, **88**, 1793; **89**, 1988; **90**, 2279; **91**, 2472; **92**, 2115, 2119; **98**, 2114.

E. Moeser. Reports, **98**, 2113; **99**, 2475; **1900**, 3317.

**Estimates.** (See *Projects.*)

Maj. Merrill, 1875, improvement from Spring Creek to Bulltown, by slackwater navigation, 12 locks and dams, $758,400, **75**, 740; **77**, 665; will be largely increased if rock foundations are not found, **75**, 742; same work estimated by J. E. Carpenter at $480,000, **75**, 744; considered too low by Maj. Merrill, **75**, 740. For temporary improvement by removal of rocks and obstructions, $7,300, **75**, 742.

Maj. Merrill, 1878, lock and dam at Burning Springs, $84,200, **78**, 813. Cause of increase from estimate of 1875, **78**, 813; **79**, 145, 1347.

**Operations.**

**1876–77.** Temporary improvement by removal of rocks, sand, gravel, and other obstructions by hired labor, **77**, 664.

**1877–78.** Removal of rocks by contract, **78**, 107, 808. Construction of wing-dams and removal of obstructions by hired labor, **78**, 108, 808.

**1878–79.** Removal of rocks and obstructions and construction of wing-dams by hired labor, **79**, 145, 1346.

**1879–80.** 27,378 trees and 11,925 snags cut and removed; 11,133 l. f. crib-dams and 3,712 l. f. brush dams built, **80**, 1835.

**1882–83.** Stone for lock and dam received and repaired, **83**, 1572.

**1883–84.** Preparations of stone continued, **84**, 1754.

**1884–85.** Machinery placed and cofferdam half finished, **85**, 1890.

**1885–86.** Cofferdam completed; foundation of mitre and river walls excavated and walls partially built upon concrete foundation, **86**, 1623.

**1886–87.** Construction of lock; river and head walls commenced, **87**, 1829.

## LITTLE KANAWHA RIVER, W. VA.—Continued.

**1887-88.** 1,090 c. y. dimension and backing stone quarried and delivered at lock site; 460 c. y. cut stone and 230 c. y. backing placed in construction of lock and dam No. 5; repairs to chute at Glenville, **88**, 1794.

**1888-89.** River wall of lock completed; construction of land wall, cofferdam, and lock-keeper's house begun, **89**, 1987.

**1889-90.** Lock-keeper's house and entire lock masonry completed; lock floor laid; 238 c. y. stone cut; 2,392 c. y. masonry laid; 4,116 c. y. earth excavated; 2,638 l. f. piles driven, and 148 c. y. concrete laid, **90**, 2278.

**1890-91.** Framing of lock gates completed; construction of dam begun; 130 c. y. stone cut, 550 c. y. laid, and 4,029 c. y. quarried, **91**, 2473.

**1891-92.** 16,700 c. y. dredged at and below dam site; 250 l. f. crib work sunk and filled in construction of the dam; protection crib, guide crib, and crib work for protection of the river bank built; lock gates, wickets, and maneuvering apparatus put in place; lock floor paved; construction and repair of plant **92**, 2115. Operation and repair of lock and dam, **92**, 2118.

**1892-93.** Dike of dam completed; shore crib below lock constructed; miscellaneous work done, **93**, 2641.

**1897-98.** Over 1,000 obstructions removed, **98**, 2113.

**1898-99.** About 700 snags and 520 c. y. rock removed from river, **99**, 2474.

**1899-1900.** About 2,500 snags and other obstructions and 1,138 c. y. rock removed from river, **1900**, 3318.

**Physical characteristics.**

Description of river, **75**, 742, 744; **78**, 806.

Falls, **75**, 740, 744, 745.

High water, **75**, 744.

Discharge, **75**, 745.

Area of water shed, **78**, 806.

Description of, 1894. Glenville, 55 miles from head of navigation, West Fork, has an elevation of 80 f., which would require 7 additional locks to give 4 f. depth, **95**, 2522.

Freshets and washouts damaging works of navigation company, and making navigation expensive and difficult, **96**, 2327.

**Private (corporate) work.**

Little Kanawha Navigation Co. began in 1867 and completed in 1874 the slack-water navigation to depth of 4 f. from mouth to Spring Creek, 43 miles, by 4 locks and dams; locks 143 f. by 23 f., **75**, 740, 744; **77**, 664.

Condition of the works of the canal company, 1894. Valued by the company at $250,000, **95**, 2520.

Leaky dams of navigation company lessening value of Government works, **94**, 2006; **95**, 2511; **96**, 2328.

**Projects.**

Maj. Merrill, 1875, temporary improvement by removing rocks and other obstructions, **75**, 742, 744; **77**, 663, 665. For permanent improvement, to depth of 4 f., from head of present slack-water navigation, Spring Creek to Bulltown, 87¾ miles, by slack-water navigation, 12 locks and dams; locks 143 f. by 23 f., with an average lift of 12¾ f., **75**, 740; **77**, 664; **78**, 813. First dam and lock proposed at Burning Springs, **78**, 813.

The project of 1876 proposed the construction of a lock and dam near Burning Springs, so as to extend slack-water navigation, for a draught of 4 f., a distance of 12 miles, and the improvement of the natural channel for an additional distance of 80 miles, by the removal of obstructions so as to obtain a channel 40 f. wide and at least 2 f. deep during 4 months of the year. Estimated cost of lock and dam, $62,000. **75**, 741. In 1878 the dimensions of the lock were increased and the cost estimated at $84,200, **78**, 813; **81**, 1989; **82**, 1958. In 1883 the estimate was increased to $135,672.47, **83**, 1573. Of the $129,300 appropriated previous to 1883 $43,300 was for the removal of obstructions, **83**, 1574. Increased cost of work due to the small appropriations, **86**, 1623. In 1888 $51,800 was estimated for completion, **88**, 1793.

**Surveys.**

From Bulltown to mouth, 1874, **75**, 73, 740, 742.

Examination, 1884, of previous works of improvement upon the river, **84**, 1754.

Examination, for locks and dams, report to contain probable price for which the U. S. could obtain possession of locks and dams, ordered by act of Aug. 17, 1894; made, 1894, by Maj. Lockwood (report unfavorable), **95**, 2520.

## LITTLE KANAWHA RIVER, W. VA. (Lock and dam, operating and care).

**Appropriations.**[a]

| | |
|---|---|
| 1892, | $611.65 |
| 1893, | 4,797.97 |
| 1894, | 2,445.32 |
| 1895, | 3,864.13 |
| 1896, | 3,230.47 |
| 1897, | 2,349.03 |
| 1898, | 1,723.53 |
| 1899, | 2,496.58 |
| 1900, | 2,421.61 |
| Total, | 23,940.29 |

**Commerce.**

Description of. Value of, at 1896, that had passed through since opening of the canal and lock, estimated at $5,271,276. **96**, 2329.

The commerce that passed through lock No. 5 during 1898 amounted to 122,405 tons, valued at about $2,176,352; 1899, 138,664 tons, valued at about $1,795,000, **99**, 2478; **1900**, 3320.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **93**, 335; **94**, 307; **95**, 342; **96**, 300; **97**, 384; **98**, 363; **99**, 426; **1900**, 490.

ENGINEERS IN CHARGE:

Maj. D. W. Lockwood, 1888–95. Reports, **93**, 2642; **94**, 2007; **95**, 2511.

Maj. J. F. Gregory, 1896–97. Reports, **96**, 2328; **97**, 2582.

Maj. W. H. Bixby, 1898–99. Report, **98**, 2115.

Capt. H. F. Hodges, 1899–. Reports, **99**, 2476; **1900**, 3319.

ASSISTANTS:

B. F. Thomas. Reports, **96**, 2330; **97**, 2583.

E. Moeser. Reports, **98**, 2117; **99**, 2479; **1900**, 3321.

**Operations.**[a]

**1894–95.** New timber and concrete floor put in lock, **95**, 2512.

**1895–96.** Upper shore crib extended; bank below lock riprapped, and miscellaneous work done, **96**, 2329.

**1896–97.** Minor repairs made to lock and dam, **97**, 2583.

**1897–98.** Minor repairs made to lock and dam, **98**, 2115.

**1898–99.** Emptying valve repaired, gates resheeted, and repairs made to guide crib and dam, **99**, 2479.

**1899–1900.** Necessary repairs made to lock and dam and about 1,750 s. f. of terreplein paved, **1900**, 3320.

**Projects.**

Leakage of works of Little Kanawha Navigation Co. lessening usefulness of Government work, **93**, 2642; **94**, 2007; **95**, 2512.

## LITTLE KANAWHA RIVER (Mouth), W. VA. (Ice harbor).

(See *Ohio River.*)

**Engineers.**

CHIEF OF ENGINEERS. Reports, **79**, 147; **80**, 195.

ENGINEER IN CHARGE. Maj. W. E. Merrill. Report, **80**, 1790.

ASSISTANT. W. E. Strong. Report, **80**, 1793.

**Private (corporate) work.**

Petition of Little Kanawha Bridge Co. with reference to the disposal of their bridge as an obstruction in the river, **80**, 1797.

**Plans.**

By Maj. Merrill, 1880, constructing two ice breakers of timber and stone below railroad bridge across the Ohio River; estimate, $6,000, **80**, 1796.

By Maj. Merrill, 1880, raising wagon bridge near mouth of Little Kanawha River 32 f. and construction of approaches thereto; estimate, $80,000, **80**, 1795.

Modification of above plan; estimate, $60,000, **80**, 1795.

**Survey.**

Ordered by act of Mar. 3, 1879, made, 1880, under direction of Maj. Merrill, **80**, 1790.

## LITTLE LAKE, LA.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 146; **81**, 197.

ENGINEER IN CHARGE. Maj. C. W. Howell. Report, **80**, 1307.

ASSISTANT. H. S. Douglass. Report, **80**, 1308.

**Plans.**

By Maj. Howell, 1881, channel 50 f. wide and 5 f. deep from New Orleans to Barataria.

Route 1. Clearing obstructions from Bayou Barataria and dredging channel at Pointe le Garde and at head and mouth of Bayou St. Denis; estimate, $78,486, **81**, 1314.

Route 2. Clearing Bayous Barataria and Dupont, cutting canals at Bayou Dupont, and connecting Bayous Dupont and Cutler; estimate, $108,158, **81**, 1314.

**Survey.**

Ordered by act of June 14, 1880, made, 1881, under direction of Maj. Howell, **81**, 1307.

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[a] See references to *Engineers in charge* for minor miscellaneous work performed each year.

## LITTLE MIAMI RIVER, OHIO. (See *Ohio River.*)

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 318.

ENGINEER IN CHARGE. Lt. Col. A. Stickney, 1892–93. Report, **93**, 2525.

ASSISTANT. Lt. H. F. Hodges. Report, **93**, 2527.

**Physical characteristics.**

Description of; exceedingly small stream at its mouth and locality unsuited for ice harbor, **93**, 2526.

**Survey.**

Examination for ice harbor at the mouth ordered by act of July 13, 1892, made in that year under direction of Lt. Col. Stickney (report unfavorable), **93**, 2525.

## LITTLE MISSOURI RIVER, ARK.

**Appropriations.**

1871, $10,000, **71**, 350.
1872, 10,000, **72**, 53.

Total, 20,000

**Commerce.**

Cotton products tributary to river, **71**, 346, 348, 349.

Difficulties of transportation and high tariffs, **71**, 349.

Duration of season of navigation, **71**, 348.

Railroad connections, **73**, 464.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **70**, 31, 66; **71**, 59; **72**, 53; **73**, 55.

ENGINEERS IN CHARGE:

Lt. Col. W. F. Raynolds, 1870–73. Reports, **71**, 346, 349; **72**, 344.

Col. J. H. Simpson, 1873. Report, **73**, 461.

ASSISTANT. J. Straszer. Reports, **71**, 349; **73**, 462.

**Operations.**

**1870–71.** Removal of obstructions, in progress, **71**, 350.

**1871–72.** Most serious obstructions removed, by means of a snag boat, from junction with the Ouachita to mouth of Antoine Creek, **72**, 53, 344.

**1872–73.** Removal of 453 snags, 647 snags cut off below low water, and 9,496 drift trees removed; 153 bowlders removed from rapids; completion of project, **73**, 55, 462, 463.

**Physical characteristics.**

Descriptions, **71**, 346–349; **73**, 463.

List of obstructions, **71**, 347.

**Projects.**

By Lt. Col. Raynolds, for removal of obstructions and improvement of channel; estimated cost, $23,000, **71**, 346, 348.

**Survey.**

By J. Straszer, 1870, **70**, 66; **71**, 59, 347.

## LITTLE MOSQUITO CREEK. (See *Mosquito Creek, S. C.*)

## LITTLE NARRAGANSETT BAY. (See *Watch Hill Cove, R. I.; Narragansett Bay (Little), R. I. and Conn.*)

## LITTLE PEDEE RIVER, S. C.

**Appropriations.**

1888, $5,000, **88**, 128.
1890, 5,000, **90**, 1213.
1892, 5,000, **92**, 1202.
1894, 4,000, **95**, 1399.
1896, 3,000, **96**, 1159.

Total, 22,000

**Commerce.**

Description of, **87**, 1114; **93**, 1473; **94**, 1076; **95**, 1399.

Aggregate amount of freight carried on the river in 1892–93, 6,153 t., **93**, 1472; in 1893–94, 8,375 t., **94**, 1075; in 1894–95, 12,438 t., **95**, 1398; in 1895–96, 17,050 t., **96**, 1159.

**Engineers.**

CHIEF OF ENGINEERS. Report, **87**, 139; **88**, 128; **89**, 153; **90**, 138; **91**, 171; **92**, 171; **93**, 185; **94**, 169; **95**, 193; **96**, 172; **97**, 215; **98**, 213; **99**, 246; **1900**, 278.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1887. Reports, **87**, 1111, 1113.

Capt. F. V. Abbot, 1888–97. Reports, **89**, 1175; **90**, 1212; **91**, 1448; **92**, 1201; **93**, 1471; **94**, 1074; **95**, 1398; **96**, 1158, **97**, 1444.

Maj. E. H. Ruffner, 1898–99. Reports, **98**, 1267; **99**, 1521.

Capt. J. C. Sanford, 1900. Report, **1900**, 1845.

ASSISTANT. R. Whitford. Reports, **89**, 1176; **91**, 1449; **92**, 1203; **93**, 1472; **94**, 1075; **95**, 1399; **96**, 1159; **97**, 1446.

**Operations.**

**1888–89.** 883 trees, logs, and snags removed from channel, and 1,771 trees cut and trimmed on the banks, **89**, 1176.

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**nded under permanent indefinite appropriation for operating and care of canals and other vigation, act of July 5, 1884, 1900, 3319.**

## LITTLE PEDEE RIVER, S. C.—Continued.

**1889–90.** 1,481 stumps and snags removed from the channel, and 1,022 trees and 221 cords of brush cut from the banks, **90**, 1214.

**1890–91.** 1,698 snags and logs and 44 cords of small snags removed from the channel, and 1,896 trees and 110 cords of brush cleared from the banks, **91**, 1449.

**1891–92.** 1,072 snags and logs and 47 cords of small snags removed from the channel, and 1,252 trees and 91 cords of brush cleared from the banks, **92**, 1203.

**1892–93.** About 3,200 snags and other obstructions removed from the river and banks, **93**, 1472.

**1894–95.** About 500 snags and other obstructions removed, **95**, 1399.

**1895–96.** About 500 snags and other obstructions removed, **96**, 1159.

**1896–97.** About 3,500 snags and other obstructions removed, **97**, 1446.

**Physical characteristics.**

Description, **87**, 1111.

**Projects.**

By Capt. Bixby, 1887, improving the river by removing snags, trees, and similar obstructions, clearing it for a 4-f. draft steam navigation from its mouth to the Lumber River, and thence for a 4-f. draft pole-boat navigation to Little Rock, S. C.; estimate, $50,000, **87**, 1114; **91**, 1448.

**Surveys.**

Ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Bixby, **87**, 1113.

See also reference under Great Pedee to survey ordered by act Mar. 3, 1879, which applies also to Little Pedee.

MAPS. **90**, 1214.

## LITTLE PIGEON RIVER. (See *French Broad and—N. C. and Tenn.*)

## LITTLE RED RIVER. (See *White, Black, etc.*)

## LITTLE RIVER, ARK.

**Commerce.**

Important, **79**, 991.

Description of (unimportant), **84**, 1407, 1408; **93**, 2087; **95**, 1967.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 88; **79**, 118; **84**, 232; **87**, 210; **93**, 271; **95**, 279.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd, 1878. Report, **79**, 990.

Capt. J. H. Handbury. Report, **84**, 1406.

Capt. H. S. Taber. Report, **87**, 1545.

Capt. J. H. Willard, 1893–95. Reports, **93**, 2087; **95**, 1965.

ASSISTANT. J. Ewens. Report, **93**, 2088.

**Physical characteristics.**

General; obstructions, **79**, 990.

Proximity of lead mines, **79**, 991.

Description of, **84**, 1407; **93**, 2087, 2089; **95**, 1966.

Enters the Red River about 3 miles above Fulton. White Cliff is about 48 miles above the entrance; in the river below this point shoals were numerous in 1893, **95**, 1967.

Table showing the variation in the rise and fall of Red River below mouth of Little River, and the consequent difficulty of entering the latter, **93**, 2088.

**Plans.**

By Maj. Benyaurd, removing obstructions, snags, logs, etc., from the river; estimate, $12,000, **79**, 991.

**Surveys.**

Examination made under direction of Maj. Benyaurd. 1878–79. Report, **79**, 990.

Examination ordered by acts of Aug. 2, 1882, and Aug. 5, 1886 (reports unfavorable), **84**, 1406; **87**, 1545.

Examination ordered by act of July 13, 1892, made, 1893, under the direction of Capt. Willard (report unfavorble), **93**, 2087. Another from Fulton to White Cliff ordered by act of Aug. 17, 1894, report submitted by Capt. Willard, 1895 (report unfavorable), **95**, 1965.

## LITTLE RIVER, ARK. AND MO. (from Homersville to its junction with the St. Francis).

**Appropriations.**

| | | |
|---|---|---|
| 1888, | $5,000.00, | **88**, 191. |
| 1890, | 3,000.00, | **90**, 1957. |
| 1893, | .80, | act Mar. 3. |
| 1894, | .13, | act Aug. 23. |
| Total, | 8,000.93 | |

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 210; **88**, 191; **89**, 225; **90**, 202; **91**, 256; **92**, 247; **93**, 279.

ENGINEER IN CHARGE. Capt. H. S. Taber, 1887–93. Reports, **87**, 1548; **89**, 1668; **90**, 1956; **91**, 2064; **92**, 1696; **93**, 2121.

## LITTLE RIVER, ARK. AND MO. (from Homersville to its junction with the St. Francis)—Continued.

**Operations.**

**1889–90.** Snagging operations begun, **90**, 1956.

**1890–91.** 109 snags removed from the channel, 25 c. y. of earth excavated, 161 trees cleared from the banks, and a dam 300 f. long built across chute, **91**, 2064.

**1891–92.** 96 snags and 8 drift piles removed from the channel, and 1,087 overhanging trees cleared from the banks, **92**, 1697.

**Projects.**

By Capt. Taber, 1887, eight months navigation from the mouth to Homersville by dam construction closing cut-off, and removal of snags and similar obstructions; estimate, $8,000, **87**, 1549; **88**, 191. Increased in 1892 to $11,000, **92**, 1697.

**Survey.**

Examination ordered by act of Aug. 5, 1886, made under direction of Capt. Taber, **87**, 1548.

## LITTLE RIVER, KY.

**Engineers.**

CHIEF OF ENGINEERS. Report, **85**, 279.

ENGINEER IN CHARGE. Maj. W. R. King. Report, **85**, 1772.

**Survey.**

Examination ordered by act of July 5, 1884, made under direction of Maj. King (report unfavorable), **85**, 1772.

## LITTLE RIVER, LA. (See *Black River*.)

**Appropriation.**

1888, $2,500, **89**, 1601.

**Commerce.**

Description of, not large, **95**, 1987.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 203; **88**, 179; **89**, 210; **90**, 189; **95**, 279.

ENGINEER IN CHARGE. Capt. J. H. Willard, 1887–95. Reports, **87**, 1498; **89**, 1600; **90**, 1881; **95**, 1984.

ASSISTANT. W. Decker. Report, **95**, 1983.

**Operations.**

**1887–89.** 2,645 logs and snags removed from the channel, and 4,300 trees and stumps removed from the banks, **89**, 1601.

**1889–90.** 120 snags removed from the channel and 515 trees from the banks, completing the project, **90**, 1881, 1882.

**Physical characteristics.**

Description, **87**, 1498; **95**, 1985.

Formed by bayous Castor and Dugdemona, and reaches Ouachita River through Catahoula prairie, which becomes a lake in high water. A tributary of Black River. **95**, 1985.

**Projects.**

By Capt. Willard, 1887, clearing the river of obstructions from Catahoula Lake to Trinity, about 25 miles; estimate, $2,500, **87**, 1499; **89**, 1600. Completed in 1890, **90**, 1881.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Willard, **87**, 1498.

Examination ordered by act of Aug. 17, 1894, made under the direction of Capt. Willard, 1895 (report favorable to removal of snags), **95**, 1984.

## LITTLE ROCK, ARK. (See *Arkansas River*.)

## LITTLE SALEM CREEK, N. J.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 102.

ENGINEER IN CHARGE. Lt. Col. H. M. Robert, 1888. Report, **89**, 876.

ASSISTANT. L. Y. Schermerhorn. Report, **89**, 877.

**Physical characteristics.**

Description of, **89**, 877.

**Survey.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Robert (report unfavorable), **89**, 877.

## LITTLE SODUS BAY HARBOR, N. Y.[a]

**Appropriations.**

1852, [b]$10,000.00, **66**, iii, 29.
1864, [c]4,101.36, act Apr. 9.
1866, 33,840.41, **66**, iii, 16, 29.
1867, 50,000.00, **67**, 33.
1869, 1,500.00 (allotted), act Apr. 10.
1870, 5,000.00, **70**, 53.
1871, 15,000.00, **71**, 51.
1872, 15,000.00, **72**, 47.
1873, 15,000.00, **73**, 48.
1874, 15,000.00, **74**, 55.
1875, 10,000.00, **75**, 59.
1876, 5,000.00, **76**, 111.
1878, 10,000.00, **78**, 133.
1879, 5,000.00, **79**, 176.
1880, 20,000.00, **80**, 2211.
1881, 20,000.00, **81**, 2445.
1882, 25,000.00, **82**, 2449.
1884, 10,000.00, **84**, 2142.
1886, 12,500.00, **86**, 1892.
1888, 16,000.00, **88**, 2082.
1890, 13,000.00, **90**, 2861.
1892, 6,000.00, **92**, 2579.
1894, 8,000.00, **95**, 3203.
1896, 8,000.00, **96**, 3149.
1899, 5,500.00, **99**, 3136.

Total, 338,441.77

**Commerce.**

Important, S. Doc. 42, 35th Cong., 1st sess., p. 148; **66**, iv, 175; **67**, 238.

Availability as a harbor of refuge, S. Doc. 42, 35th Cong., 1st sess., p. 148; **68**, 248; **69**, 175.

Commercial importance of Little Sodus Bay, **66**, iv, 170; **68**, 248; **75**, 342; **79**, 1731.

East piers not deemed necessary, **66**, iv, 170, 172, 175.

The value of the commerce in 1895 was estimated at $268,800, **96**, 3149.

63,501 tons of coal were shipped in 1896, **97**, 3276.

The total commerce in 1897 was estimated to amount to 68,888 tons, **98**, 2804.

Chiefly coal, **99**, 3136.

**Contracts.**

**1866.** A. P. Grant, dredging; J. W. P. Allen, towing scows; R. Nelson Gere, materials and labor; Ontario Iron Works, materials and labor; J. N. Collins & Co., materials and labor, **66**, iv, 177.

**1867.** W. J. Baker, dredging, 24 cents, **67**, 243. J. N. Collins & Co., materials; S. B. Robinson, labor; C. R. Parsons, materials; R. R. Dodge, materials, **68**, 252.

**1868.** R. R. Dodge, materials; R. R. Dodge, materials and labor; Hart & Jennings, materials, **68**, 251.

**1869.** Hart & Jennings, materials and labor; John King, materials and labor, **69**, 177.

**1871.** E. H. French, materials and labor; E. H. French, dredging, **71**, 233.

**1872.** Post & Henderson, materials; C. J. De Graw, materials, **72**, 257. H. J. Mowry, materials, **73**, 367.

**1873.** T. B. Hart, materials, **73**, 367.

**1874.** C. J. De Graw, materials and labor, **75**, 341.

**1875.** C. J. De Graw, materials and labor, **75**, 342.

**1879.** C. F. Dunbar, dredging, 18 cents per c. y., **80**, 2212.

**1880.** W. D. Taylor, iron, **81**, 2446. R. J. Myers and H. C. Post, timber, **81**, 2446.

**1881.** D. W. McConnell, dredging, 17¾ cents per c. y; R. J. Myers and H. E. Post, timber; W. D. Taylor, iron, **81**, 2446.

**1882.** Kelly & Bennerman, pier extension, **83**, 1947. A. J. Packard, iron, **83**, 1946.

**1895.** E. J. Hingston, dredging 10,000 c. y., at 47 cents per c. y., p. m., **95**, 3202.

**1897.** W. J. Daly, dredging, 49$\frac{2}{10}$ and 18 cents per c. y., s. m., **97**, 3277.

**Documents.** (Not published in reports.)

S. Doc. 16, 34th Cong., 3d sess. Report of Maj. J. D. Graham, for 1855–56.

S. Doc. 42, 35th Cong., 1st sess., p. 148.

**Engineers.**

CHIEF OF ENGINEERS.

Letter to officer in charge, directing him to carry out the wishes of the "Ontario Bay Harbor Improvement Association," S. Doc. 42, 35th Cong., 1st sess., p. 150.

Reports, **66**, 4, ii, 41, 42, iii, 1629; **67**, 33; **68**, 45; **69**, 41; **70**, 53; **71**, 51; **72**, 47; **73**, 47; **74**, 54; **75**, 59; **76**, 111; **77**, 118; **78**, 133; **79**, 176; **80**, 132; **81**, 318; **82**, 312; **83**, 321; **84**, 325; **85**, 350; **86**, 344; **87**, 310; **88**, 283; **89**, 335; **90**, 303; **91**, 380; **92**, 359; **93**, 412; **94**, 386; **95**, 421; **96**, 378; **97**, 475; **98**, 464; **99**, 545; **1900**, 614.

ENGINEERS IN CHARGE.

Capt. T. W. Maurice, 1828; **74**, 256.

Maj. W. Turnbull, 1845; S. Doc. 42, 35th Cong., 1st sess., pp. 3, 22; **74**, 256.

Maj. J. D. Graham, 1857; **66**, 4. Report, S. Doc. 42, 35th Cong., 1st sess., p. 147.

Maj. C. E. Blunt, 1866–69; **66**, ii, 41.

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[a] Survey. Report, Jan. 2, 1829; estimate, $32,327.59. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] S. Doc. 42, 35th Cong., 1st sess., p. 147.
[c] Relief claims.

## LITTLE SODUS BAY HARBOR, N. Y.—Continued.

Reports, **66**, iv, 170, 172, 175; **67**, 237, 243, 257; **68**, 247, 251, 252.

Maj. M. D. McAlester, 1869; **69**, 170.

Capt. F. Harwood, 1869; **69**, 170.

Maj. N. Bowen, 1869–71; **69**, 170. Reports, **69**, 175; **70**, 207.

Maj. J. M. Wilson, 1871–76. Reports, **71**, 233; **72**, 257; **73**, 367; **74**, 255; **75**, 341.

Maj. W. McFarland, 1876–83. Reports, **76**, ii, 591; **77**, 981; **78**, 1276; **79**, 1781; **80**, 2210; **81**, 2443; **82**, 2448.

Lt. Col. H. M. Robert, 1883–85. Reports, **83**, 1946; **84**, 2142.

Capt. E. Maguire, 1885–87. Reports, **85**, 2276; **86**, 1891.

Capt. C. F. Palfrey, 1887–90. Reports, **87**, 2379; **88**, 2079; **89**, 2415.

Maj. M. B. Adams, 1890. Report, **90**, 2858.

Capt. D. C. Kingman, 1891–95. Reports, **91**, 2909; **92**, 2572; **93**, 3146; **94**, 2470; **95**, 3198.

Maj. W. S. Stanton, 1896–98. Reports, **96**, 3145; **97**, 3276; **98**, 2804.

Capt. G. D. Fitch, 1899—. Reports, **99**, 3135; **1900**, 4168.

ASSISTANT. Lt. B. D. Greene, 1870, **70**, 208.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Bowen, repairs, $25,000, **69**, 41, 175,

By Maj. McFarland, pier extension, $60,000, **79**, 1731.

**Operations.**

**1854.** 240 l. f. west pier; dredging, S. Doc. 42, 35th Cong., 1st sess., p. 147, **74**, 256.

**1866–67.** 60 l. f. west pier; dredging, **67**, 237.

**1867–68.** 650 l. f. west breakwater and 500 l. f. west pier; dredging, **68**, 46, 247.

**1868–69.** 300 l. f. west pier; dredging, **69**, 41, 175.

**1869–70.** 120 l. f. west pier; repairs, **70**, 53, 207.

**1870–71.** 210 l. f. west breakwater; 100 f. of superstructure; repairs, **71**, 51, 233.

**1871–72.** 30 l. f. west pier; 22,625 c. y., dredged; repairs to west pier and breakwater, **72**, 47, 257.

**1872–73.** 270 l. f. east pier; 1,783 c. y. dredged; 210 f. of superstructure, **73**, 47, 367.

**1873–74.** 240 l. f. east breakwater and 243 l. f. east pier; 170 f. of superstructure; dredging, **74**, 55, 258.

**1874–75.** 540 l. f. east breakwater; 1,592 c. y. dredged; 130 f. of superstructure; repairs, **75**, 59, 341.

**1875–76.** 660 l. f. east breakwater; 795 f. of superstructure, **76**, 111, ii, 591.

**1876–77.** Repairs, **77**, 118, 981.

**1877–78.** 150 l. f. east pier; repairs, **78**, 133, 1276.

**1878–79.** Repairs, **79**, 176.

**1879–80.** Filling placed in east pier; 1,000 l. f. west pier superstructure built; 9,678 c. y. dredged, **80**, 2210.

**1880–81.** Work on piers and dredging continued, **81**, 2444.

**1881–82.** East pier extended 757 f., and west pier 242 f.; 40,000 c. y. sand dredged from channel between piers, **82**, 2448.

**1882–83.** East pier extended 360 f., and west pier 150 f., **83**, 1946.

**1883–84.** West pier extended 120 f., east pier 240 f., **84**, 2142.

**1884–85.** 100 l. f. crib work added to west pier and riprap foundation laid for remainder of extension, **85**, 2277.

**1885–86.** West pier extended 100 f. and 200 l. f. superstructure built, and stone dike built between end of east breakwater and shore, **86**, 1891.

**1887–88.** 200 l. f. of stake and fascine shore revetment built; 512 l. f. of east pier superstructure rebuilt; outer end of west pier repaired, and minor repairs to deck of east breakwater, **88**, 2081.

**1888–89.** 3 pockets in west pier reballasted and 1,020 l. f. of superstructure renewed; 980 l. f. of east breakwater superstructure renewed, **89**, 2416.

**1889–90.** Repairs to east and west piers, **90**, 2859.

**1891–92.** 800 l. f. of east breakwater superstructure built; 541 c. y. of hardpan and 7,257 c. y. of sand dredged, **92**, 2579.

**1893–94.** 14,367 c. y. dredged, **94**, 2474.

**1895–96.** (History of works of improvement, **96**, 3145.) 10,638 c. y. dredged, **96**, 3145.

**1896–97.** 21,080 c. y. dredged, **97**, 3276.

**1897–98.** 28,384 c. y. dredged and minor repairs made to both piers, **98**, 2804.

**1898–99.** Over 8,000 c. y. dredged; east and west piers repaired, **99**, 3135.

**1899–1900.** Dredging plant repaired, **1900**, 4168.

**Physical characteristics.**

General description, S. Doc. 42, 35th Cong., 1st sess., p. 148.

Condition of the bay as shown by the survey of 1828, **74**, 256.

Depth of water, **66**, iii, 16, iv, 175.

Channel requires more or less dredging annually because of sand movement, **1900**, 4168.

**Plans.** (See *Estimates* and *Projects*.)

By Maj. Bowen, restoration of piers and the rebuilding of the breakwaters, **69**, 41, 175.

By Maj. McFarland, extension of piers to 12-f. curve, **79**, 1731.

## LITTLE SODUS BAY HARBOR, N. Y.—Continued.

**Private (corporate) work.**
Organization of Ontario Bay Harbor Improvement Association, 1857, to aid in the improvement of Little Sodus Bay, by joining its capital (about $6,000) to the Government appropriations, S. Doc. 42, 35th Cong., 1st sess., pp. 148, 150, 152, 153.

**Projects.** (See *Estimates* and *Plans*.)
By Capt. Maurice, 1829, to close one of two openings into the bay by a dike 130 y. long; also for the construction of two parallel piers, each 290 y. long, at an estimated cost of $32,327.59, **74**, 256.

By Maj. Graham, 1857, (1) completion of west pier; (2) construction of an east pier, with cribs 32 f. long, 20 f. wide, and 10 f. high; (3) dredging channel to a depth of 12 f.; at a total estimated cost of $52,602.18, S. Doc. 42, 35th Cong., 1st sess., pp. 147, 148, **76**, ii, 592.

By Maj. Blunt, extension of west pier and connection with western shore, and for dredging a channel 400 f. wide and 12 f. deep (deeming an east pier unnecessary); estimate, $80,000, **66**, iii, 16, iv, 170, 175.

By Maj. Bowen, construction of an east pier parallel to and 250 f. from the west pier, connected at its inner end with the eastern shore by a breakwater; estimate, $62,100, **71**, 234; **72**, 257.

The present project, adopted in 1881, was an expansion of the earlier projects, and proposed to furnish a channel of entrance not less than 15 f. deep by the closure of one side of the bay by a lateral pier of crib work filled with stone, in connection with two parallel piers extending out into the lake, **79**, 1731; **81**, 2444; **87**, 2379. The total amount appropriated from 1852 to 1886, inclusive, was $281,941.77; amount estimated to complete project, $32,500, **86**, 344, 1892; **87**, 2381. Increased to $46,600 in 1889, **89**, 2417, and to $58,500 in 1891, **91**, 2911.

In 1896 the Chief of Engineers authorized that the then available funds might be applied to redredging in maintenance of the channel to a depth of 15 f. and width of 150 f. between the piers and 170 f. through a hard-pan shoal toward the outer ends and in advance of them, and to making necessary repairs to and maintenance of piers and breakwater, and to dredging plant, **98**, 2804.

**Secretary of War.**
Circular from War Department stating conditions upon which operations may be carried on under direction of the officer in charge to the limit of funds provided by the State, by municipal or private parties, S. Doc. 42, 35th Cong., 1st sess., p. 151.

**Surveys.**
Included in survey of harbors on the southern shore of Lake Ontario, between the Genesee and Oswego rivers, made by Capt. Maurice, 1828, **74**, 255, 256; **76**, ii, 591.

Under direction of Maj. Turnbull, 1845, **74**, 256.

Resurvey, 1852, **74**, 256.

Soundings taken, 1866, **66**, iv, 175.

By Lt. Greene, 1870, **70**, 208.

Under direction of Maj. Wilson, 1872, **74**, 257.

Minor surveys, **95**, 3202; **97**, 3276; **99**, 3135; **1900**, 4168.

Maps.
Of Little Sodus Harbor, **76**, ii, 591; June 30, 1879, **79**, 1731.
**81**, 2446.

## LITTLE TENNESSEE RIVER, TENN.

**Appropriation.**
1882, $5,000, **82**, 1869.

**Commerce.**
Important, **75**, 815.

**Engineers.**
Chief of Engineers. Reports, **75**, 78; **76**, 87; **81**, 258; **82**, 252; **83**, 259; **84**, 259; **85**, 278; **86**, 270; **87**, 232; **88**, 209.

Engineers in Charge:
Maj. W. McFarland. Reports, **75**, 813; **76**, 715.
Maj. W. R. King, 1881–86. Reports, **82**, 1868, 1871; **83**, 1507; **84**, 1659; **85**, 1769.
Lt. Col. J. W. Barlow, 1886–88. Reports, **86**, 1524; **87**, 1752; **88**, 1604.

Assistants:
M. Kingsley. Reports, **75**, 814; **76**, 716.
J. H. Mayhew. Report, **82**, 1872.

**Obstructions.** (See *Physical characteristics.*)

**Operations.**
**1882–83.** 110 c. y. rocks and bowlders excavated from channel; 156 c. y. riprap dam and 11 c. y. embankment built; 110 snags and trees removed, **83**, 1507.

**1883–84.** 1,409 c. y. rock, bowlders, and gravel, 182 snags, and 421 trees removed, and 1,380 c. y. rock placed in wing dams, **84**, 1660.

**Physical characteristics.**
General, **75**, 814; **76**, 715–717; **88**, 1604.

Products of the country adjacent, **75**, 815; **76**, 717,

List of obstructions, **75**, 816; **76**, 716.

### LITTLE TENNESSEE RIVER, TENN.—Continued.

**Plan.**
By M. Kingsley, improvement of the river by the construction of wing dams, by the excavation of rock and gravel, and by the clearing off of brush, snags, and trees, at an estimated cost of, originally, $45,000; subsequently increased by Maj. McFarland to $55,000, **75**, 814, 817.

**Projects.**
By Maj. King, 1882, improvement from its mouth to the mouth of the Tellico River, about 13 miles, by removal of snags, logs, bowlders, and similar obstructions, and construction of stone wing dams, securing a channel 40 f. wide and 2 f. deep; estimate, $23,724, **82**, 1868, 1869.

**Survey.**
By M. Kingsley, 1874–75. Reports, **75**, 814; **76**, 716.
Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Maj. King, **82**, 1868.

### LITTLE TRAVERSE BAY, MICH. (Harbor of refuge, near Petoskey). (See *Petoskey Harbor, Mich.*)

**Engineers.**
CHIEF OF ENGINEERS. Report, **85**, 324.
ENGINEER IN CHARGE. Capt. D. W. Lockwood. Report, **85**, 2095.

**Survey.**
Examination ordered by act of July 5, 1884, made under direction of Capt. Lockwood (report unfavorable), **85**, 2095.

### LITTLE WABASH RIVER, ILL.

**Commerce.**
Description of; chiefly grain. Value of the stream to commerce dependent on Wabash River, a but partly improved stream. **93**, 2570.

**Engineers.**
CHIEF OF ENGINEERS. Report, **93**, 324.
ENGINEER IN CHARGE. Lt. Col. J. G. Lydecker, 1892–93. Report, **93**, 2569.
ASSISTANT. O. L. Petitdidier. Report, **93**, 2571.

**Obstructions.**
Navigation obstructed by a milldam at Carmi, and between this point and the mouth there is a drawless wagon bridge, **93**, 2570.

**Physical characteristics.**
Description of. About 250 miles long, emptying into the Wabash about 15 miles from the latter's confluence with the Ohio. **93**, 2570.

**Private (State) work.**
A lock and dam was completed, 1868, by State of Illinois, but after being operated for a year it was destroyed by fire, **93**, 2570.

**Survey.**
Examination ordered by act of July 13, 1892, made under the direction of Lt. Col. Lydecker in that year (report unfavorable), **93**, 2569.

### LITTLE WICOMICO RIVER. (See *Wicomico River, Va.*)

### LITTLE WOODS HOLE HARBOR, MASS. (See *Woods Hole.*)

### LLOYDS HARBOR AND COLD SPRING BAY, N. Y. (Channel between).

**Commerce.**
Important, **81**, 615.
Description of, **97**, 1166.
In 1897 its annual value was estimated at $2,600,000, **97**, 1166.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 80; **81**, 96; **97**, 139.
ENGINEERS IN CHARGE:
Maj. J. W. Barlow, 1881. Report, **81**, 613.
Maj. H. M. Adams, 1896–97. Report **97**, 1165.
ASSISTANT. W. W. Starr. Report, **81**, 614.

**Physical characteristics.**
Description of. A shallow inlet 2½ miles long on the north shore of Long Island Sound, and situated about 40 miles by water from New York City. **97**, 1165.

**Plans.**
By Maj. Barlow, 1890 dredging a channel 200 f. wide and 10 f. deep at m. l. w., with jetties at Cold Springs; estimate $287, 534.40, **81**, 615.

**Surveys.**
Ordered by act of June 14, 1880, made under direction of Maj. Barlow, 1880, **81**, 613.
Examination with a view to its connection with Cold Spring Bay ordered by act of June 3, 1896, made in the same year by Maj. Adams (report unfavorable), **97**, 1165.

## LOCKWOODS FOLLY RIVER, N. C.

**Appropriations.**

1890, $5,000, **91**, 1403.
1892, 3,000, **92**, 1179.
1894, 10,000, **95**, 1345.

Total, 18,000

**Commerce.**

Unimportant and decreasing, **93**, 1433; **95**, 1345.

Estimated in 1892–93 that the total value of receipts and shipments amounted to $65,606 in that year, **93**, 1433.

Description of, **93**, 1433, 1434.

**Contracts.**

**1891.** Atlas Dredging Co., dredging, 20 cents per c. y., **91**, 1404.

**1894.** Virginia Dredging Co., dredging, from 8,000 to 12,000 c. y., 19 cents per c. y., p. m., **95**, 1346.

**Engineers.**

Chief of Engineers. Reports, **80**, 125; **87**, 139; **91**, 167; **92**, 167; **93**, 180; **94**, 166; **95**, 189; **96**, 170; **97**, 211.

Engineers in Charge:

Capt. C. B. Phillips. Report, **80**, 909.

Capt. W. H. Bixby, 1887–92. Reports, **87**, 1099; **91**, 1402.

Maj. W. S. Stanton, 1892–95. Reports, **92**, 1177; **93**, 1432; **94**, 1056; **95**, 1345.

Lt. Col. D. P. Heap, 1896. Report, **96**, 1140.

Capt. W. E. Craighill, 1897. Report, **97**, 1417.

Assistants:

C. W. Forster. Report, **80**, 910.
J. H. Bacon. Report, **87**, 1101.
E. D. Thompson. Report, **92**, 1179.
C. Humphreys. Report, **96**, 1142.

**Operations.**

**1891–92.** 20,777 c. y. dredged, **92**, 1178.

**1894–95.** 9,478 c. y., p. m., dredged, **95**, 1345.

**1895–96.** 51,042 c. y., p. m., dredged, **96**, 1141.

**Physical characteristics.**

Description of, **92**, 1177; **93**, 1433.

**Plans.**

By Capt. Phillips, 1880, improving river, 20 miles from its mouth, by dredging a channel 75 f. wide, 8 f. deep, and 2,100 y. long through bar at mouth, also closing cut-off below Mercers Landing; estimate, $17,379.95, **80**, 909.

By Capt. Bixby, 1887, formation of a dredged channel 7 f. deep and 100 f. wide from the mouth to the head of navigation at Lockwoods Folly Bridge; estimate, $40,000, **87**, 1101.

**Projects.**

By Capt. Bixby, 1887, excavation of a 6 f. low-water channel 100 f. wide from the mouth to the head of navigation at Lockwoods Folly Bridge, a distance of 25 miles; estimate, $40,000, **87**, 1101; **91**, 1402.

In 1892 the Secretary of War authorized the withholding from expenditure the appropriation of $3,000 made in 1893, no dredging at advantageous prices being possible because of the small appropriation, **93**, 1433.

Lt. Col. Heap, 1896, estimated that $300 would be required annually for maintenance, **96**, 1141.

**Surveys.**

Ordered by act of Mar. 3, 1879, made, 1880, under direction of Capt. Phillips, **79**, 95; **80**, 909.

Ordered by act of Aug. 5, 1886, made under direction of Capt. Bixby, **87**, 1100.

Maps. **87**, 1100; **92**, Atlas, 37, 38; **96**, 1142.

## LOGGY BAYOU, LAKE BISTENAU, AND THE DORCHEAT, LA. (See also *Red River, La. and Ark.*)

**Appropriation.**

1884, $5,000, **85**, 1497.

**Engineers.**

Chief of Engineers. Reports, **84**, 227; **85**, 233; **86**, 230; **87**, 195.

Engineers in Charge:

Capt. A. M. Miller. Report, **84**, 1363.

Capt. E. Bergland, 1884–86. Reports, **85**, 1496; **86**, 1350.

Capt. J. H. Willard, 1886–87. Report, **87**, 1454.

Assistant. P. C. Montgomery. Report, **84**, 1363.

**Operations.**

**1884–85.** Removal of obstructions from Murrells Point, on the Dorcheat, to the mouth of Loggy Bayou, **85**, 1496.

**Projects.**

From the examination made in 1882 it was estimated that the cost of removing obstructions to increase the season of navigation two months would cost $19,338, **84**, 1366; **85**, 1476.

**Survey.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Miller (report unfavorable) (see *Projects*), **84**, 1363.

## LONG BEACH, N. Y. (See *Baldwin River, N. Y.*)

## LONG BEACH INLET. (See *Jamaica Bay, N. Y.*)

**LONG BRANCH, N. J. (Breakwater.)**

**Commerce.**
No requirement for harbor of refuge, **84**, 764.

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 122.
ENGINEER IN CHARGE. Lt. Col. G. L. Gillespie. Report, **84**, 763.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under direction of Lt. Col. Gillespie (report unfavorable), **84**, 123.

**LONG ISLAND COAST. (Including Rockaway Inlet, Canarsie and Sheepshead Bays,** q. v.)

**Commerce.**
Important, **78**, 426; **79**, 400, 401.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 58; **79**, 66.
ENGINEER IN CHARGE. Lt. Col. Newton. Reports, **78**, 424; **79**, 399.
ASSISTANT. R. H. Talcott. Report, **79**, 401.

**Physical characteristics.**
Description, **78**, 425; **79**, 399–402.

**Plans.**
Discussion of plans by Lt. Col. Newton, 1878, for a breakwater and improving inlets, **78**, 425–427; **79**, 400.
No permanent improvement possible for Rockaway Inlet, 1879. The improvement of Canarsie Bay by improving the channel by means of dikes, inclosing a tidal basin; estimate, $88,000; recommended. Similar improvements for Sheepshead Bay; estimate, $10,000. **79**, 400.

**Surveys.**
By R. H. Talcott, 1878, between Rockaway Inlet and Coney Island, including Canarsie and Sheepshead bays, **78**, 58; **79**, 66, 399, 401.

**LONG TOM RIVER, OREG.**

**Appropriation.**
1899, [a]$3,000.

**Commerce.**
Description of. Limited, but would probably be increased if stream were improved. **98**, 3049. Shipment of about 300 t. grain made 1899–1900, the first shipment by river in twenty years, **1900**, 4346.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **98**, 509; **99**, 590; **1900**, 666.
ENGINEERS IN CHARGE.
Maj. W. L. Fisk, 1896–99. Reports, **98**, 3045; **99**, 3233.
Capt. W. C. Langfitt, 1899; **1900**, 4345.
Capt. W. W. Harts, 1900–. Report, **1900**, 4346.

**Operations.**
**1899–1900.** Nearly 1,500 s. y. brush and 1,000 snags, etc., removed, **1900**, 4346.

**Physical characteristics.**
Description of. Stream a tributary of the Willamette, 80 miles south of Portland; 122 miles distant by river. **98**, 3045.

**Projects.**
By Maj. Fisk, 1898. Removing overhanging trees from banks and snags from the channel, from the mouth up to Monroe, about 10 miles, to secure a navigable channel on high-water stages during the rainy seasons, **99**, 3233.

**Survey.**
Examination from mouth to Monroe, ordered by act of June 16, 1896, made, 1898, by Capt. Fisk (report favorable), **98**, 3045.

**LOOSASCOONA RIVER, MISS.**

**Engineers.**
CHIEF OF ENGINEERS. Report, **84**, 226.
ENGINEER IN CHARGE. Capt. A. M. Miller. Report, **84**, 1344.
ASSISTANT. W. S. Davis. Report, **84**, 1344.

**Survey.**
Examination ordered by act of Aug. 2, 1882, made under direction of Maj. Miller (report unfavorable), **84**, 1344.

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[a] Transferred from appropriation for Willamette River above Portland, **99**, 3234.

## LORAINE. (See *Black River Harbor, Ohio.*)

## LOUISA FORK OF SANDY RIVER, VA. (See *Big Sandy River.*)

## LOUISIANA, MO. (See *Mississippi River from Des Moines Rapids to the mouth of the Illinois River.*)

## LOUISIANA WATER COURSES. (Remarks on improvement.)

**Engineers.**

ENGINEER IN CHARGE. Maj. C. W. Howell. Report, **80**, 1189.

ASSISTANT. H. C. Collins. Report, **80**, 1190.

**Survey.**

Ordered by act of Mar. 3, 1879, made, 1880, under direction of Maj. Howell, **80**, 1189.

## LOUISIANA WATERS. (See *Florida Waters.*)

## LOUISVILLE AND PORTLAND CANAL. (See *Ohio River Falls.*)

## LOUISVILLE CANAL. (See *Ohio River.*)

## LOVEJOY NARROWS. (See *Kennebec River, Me.*)

## LOWER CLEARWATER RIVER, IDAHO. (See *Clearwater River, Idaho.*)

## LOWER MACHODOC CREEK. (See *Machodoc Creek, Va.*)

## LOWER THOROUGHFARE, MD. (See *Deals Island.*)

## LOWER WHITE RIVER, MASS. (See *Clarendon* and ——.)

## LOWER WILLAMETTE AND COLUMBIA RIVERS, OREG. (See *Willamette* and *Columbia rivers, Oreg.*)

## LUBEC CHANNEL, ME. (See *St. Croix River, Me.*)

**Appropriations.**

| | | | |
|---|---|---|---|
| 1879, | $44,000, | **79**, | 44. |
| 1880, | 20,000, | **80**, | 327. |
| 1881, | 45,000, | **81**, | 460. |
| 1882, | 20,000, | **82**, | 488. |
| 1884, | 10,000, | **84**, | 461. |
| 1886, | 10,000, | **86**, | 530. |
| 1888, | 20,000, | **88**, | 375. |
| 1894, | [a]35,000, | **95**, | 540. |
| | 5,000, | **95**, | 540. |
| 1896, | 32,000, | **96**, | 541. |
| 1899, | 25,000, | **99**, | 1018. |
| Total, | 266,000 | | |

**Commerce.**

Benefits to, from improvement, **88**, 374.

**Contracts.**

**1880.** Atlantic Dredging Co., dredging, **80**, 328.

**1881.** Moore & Wright, dredging, **81**, 460.

**1882.** Moore & Wright, dredging, 37 cents per c. y., **82**, 488.

**1884.** W. S. White, jetty construction, **84**, 461. Moore & Wright, dredging, 42 cents per c. y., **85**, 464. G. W. Townsend, rock removal, $24.90 per c. y., **85**, 462.

**1887.** Moore & Wright, dredging, 35 cents per c. y., **87**, 437.

**1889.** A. R. Wright, dredging, 35 cents per c. y., **89**, 505.

**1895.** Moore & Wright, dredging, 31 cents per c. y., p. m. (62,000), **95**, 541.

**1897.** Moore & Wright, dredging, $1, and 27 cents per c. y., s. m. ($52,180), **97**, 771.

**1899.** A. R. Wright, dredging, 25 cents per c. y., s. m. ($31,250); bowlders exceeding 5 tons, $5 per short ton, **99**, 1018.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **78**, 46; **79**, 44, 52; **80**, 63; **81**, 64; **82**, 63; **83**, 59; **84**, 67; **85**, 55; **86**, 54; **87**, 14; **88**, 11; **89**, 19; **90**, 15; **91**, 19, 33, 424; **92**, 24; **93**, 22; **94**, 21; **95**, 23; **96**, 24; **97**, 26; **98**, 36; **99**, 44; **1900**, 45.

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[a] See *St. Croix River, Me.*

## LUBEC CHANNEL, ME.—Continued.

Engineers in Charge:
Lt. Col. G. Thom, 1879–83. Reports, **79**, 246, 279; (Col.), **80**, 325; **81**, 459; **82**, 486.
Col. C. E. Blunt, 1883–86. Reports, **83**, 407; **84**, 460; **85**, 462.
Maj. J. A. Smith, 1886–92. Reports, **86**, 527; **87**, 436; (Lt. Col.), **88**, 374; **89**, 504; **90**, 428; **91**, 571.
Lt. Col. P. C. Hains, 1892–94. Reports, **92**, 495; **93**, 671; **94**, 491.
Lt. Col. D. P. Heap, 1895. Report, **95**, 539.
Lt. Col. A. N. Damrell, 1896. Report, **96**, 540.
Maj. R. L. Hoxie, 1897–98. Reports, **97**, 770; **98**, 813.
Maj. S. W. Roessler, 1899–. Reports, **99**, 1018; **1900**, 1074.

Assistant. A. C. Both. Report, **79**, 280.

**Operations.**
**1879–80.** 3,720 c. y. dredged, **80**, 326; **81**, 459.
**1880–81.** 13,327 c. y. dredged, **81**, 459; **82**, 487.
**1881–82.** 41,330 c. y. dredged, **82**, 64, 487.
**1882–83.** 45,831 c. y. dredged from channel, **83**, 408.
**1884–85.** 134 l. f. stone jetty built; rock removal commenced; 23,272 c. y. dredged, **85**, 462.
**1885–86.** 5,792 c. y. dredged, **86**, 528.
**1886–87.** 966 c. y. dredged from channel, **87**, 436.
**1887–88.** 24,172 c. y. dredged, **88**, 374.
**1889–90.** 20,286 c. y. dredged, **90**, 428.
**1890–91.** 29,172 c. y. dredged, **91**, 571.
**1895–96.** About 100,000 c. y. dredged, **96**, 541.
**1896–97.** About 20,000 c. y. dredged, **97**, 770.
**1897–98.** About 56,000 c. y. dredged, **98**, 814.
**1899–1900.** 9,150 c. y. dredged, **1900**, 1074.

**Physical characteristics.**
Description, **79**, 279–281.
Tidal observations, **79**, 279, 281.
Relation of channel to surrounding points, **88**, 374.

**Plans.**
By Lt. Col. Smith, 1891, widening the existing channel to 650 f. at m. l. w.; estimate, $231,000, **91**, 618.

**Projects.**
By Lt. Col. Thom, 1879, improving bars between the Narrows and Western Bar Beacon, 2½ miles, by widening the channel to 200 f. and deepening to 12 f.; estimate, $48,000, **79**, 44, 246, 280, 282.
Revised in 1880 to $130,000, **80**, 326. Amended in 1881 and 1882 to $154,000, **81**, 460; **82**, 487.
From 1879 to 1882, inclusive, $129,000 was appropriated.
In 1883 Col. Blunt proposed increasing the width of the channel to 275 f. and depth to 15 f.; estimate, $113,000, **83**, 409; **85**, 463.
In 1884 the aggregate of appropriations was $139,000, when the estimate to complete was amended to $167,500, **86**, 529.
Amount estimated for completion in 1888, $2,500, **88**, 375.
Project completed in 1891, at a cost of $168,929, **92**, 496.
By Lt. Col. Smith, 1891 (adopted 1895), dredging a 12-f. channel, m. l. w., with least width of 500 f.; estimate, 1895, $150,000, **96**, 540.

**Surveys.**
By A. C. Both, 1878–79, **78**, 46; **79**, 44, 52, 279.
Examination of the channel, made, 1890, under direction of Lt. Col. Smith, **91**, 617.

Maps.
Sketch showing location of proposed channel, **79**, 280.
**84**, 460.

## LUDINGTON (Pere Marquette) HARBOR, MICH.

**Appropriations.**
1867, $50,000, **67**, 25.
1869, 31,185 (allotted), **69**, 22.
1870, 10,000, **70**, 41.
1871, 10,000, **71**, 39.
1872, 10,000, **72**, 37.
1873, 25,000, **73**, 37.
1874, 20,000, **74**, 43.
1875, 10,000, **75**, 47.
1876, 10,000, **76**, 101.
1878, 15,000, **78**, 121, 1205.
1879, 5,000, **79**, 162, 1608.
1880, 8,000, **80**, 2014.
1881, 10,000, **81**, 2209.

**Appropriations**—Continued.
1882, 12,000, **82**, 2291.
1884, 10,000, **84**, 1978.
1886, 56,250, **86**, 1761.
1888, 60,000, **88**, 1906.
1892, 5,000, **92**, 2327.
1894, 6,000, **95**, 2807.
1896, 25,000, **96**, 2705.
1899, 25,000, **99**, 2938.

Total, 413,435

**Commerce.**
Importance as harbor of refuge, **68**, 132; **69**, 88; **70**, 40, 131; **76**, ii, 476.

## LUDINGTON (Pere Marquette) HARBOR, MICH.—Continued.

Benefits of improvement, **68**, 132; **75**, 47; **76**, ii, 477.

Vessels lost between Big and Little Point Sable, between 1848 and 1881, **82**, 2300.

In 1897 the harbor had large local commerce, and was an important link in a line for moving freight to and from the Northwest and the Atlantic seaboard, **97**, 2952.

**Contracts.**

**1867.** P. M. Danaher, materials, **70**, 41. Ledlie & Corse, materials; R. N. Gere, materials; Hasbrouck & Conro, labor and dredging, **67**, 115.

**1869.** P. M. Danaher, materials and labor, **69**, 88.

**1870.** Pierce & Whaling, materials and labor; D. Dewar, materials and labor, **71**, 137, 138, 139.

**1872.** Dodge & Squier, materials and labor, **73**, 265, 266.

**1873.** W. Nicolls, materials and labor, **73**, 265.

**1876.** D. Dewar, materials and labor, **77**, 906, 907.

**1877.** D. Dewar, materials and labor, **78**, 1203.

**1878.** N. S. Gere,[a] materials and labor, **79**, 1606, 1609.

**1879.** Dewar & Corlett, materials and labor, **80**, 2014. D. Dewar, pier extension, superstructure, and dredging, **81**, 2208.

**1881.** D. Dewar, pier construction and dredging, **82**, 2291.

**1882.** T. H. Smith, dredging, 29 cents per c. y., **83**, 1816.

**1883.** C. E. Mitchell, crib construction, **85**, 2074.

**1889.** Truman & Cooper, pier construction, $52,417.97; pile-pier construction, $55,568.16, **89**, 2175.

**1896.** W. A. Starke, dredging, **97**, 2931.

**1897.** W. Brownrigg, pier repairs, $8,851.31, **97**, 2703.

**1899.** Green's Dredging Co., dredging; N. J. Gaylord, pier repairs (removing old work, piles, lumber, ironwork, stone), $14,777.35, **99**, 2938.

**1900.** Green's Dredging Co., dredging, **1900**, 3918.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **67**, 25; **68**, 35; **69**, 30; **70**, 40; **71**, 38; **72**, 36; **73**, 37; **74**, 43; **75**, 47; **76**, 100; **77**, 106; **78**, 121; **79**, 162; **80**, 215; **81**, 292; **82**, 286, 2292; **83**, 294; **84**, 295, 301; **85**, 317, 324, 2090; **86**, 312; **87**, 279; **88**, 253; **89**, 296; **90**, 267, 2625; **91**, 338; **92**, 324; **93**, 375; **94**, 348; **95**, 384; **96**, 340; **97**, 430, 435; **98**, 418; **99**, 499; **1900**, 562.

BOARD OF ENGINEERS. Convened by S. O. No. 181, C. of E., 1884, to report upon a plan with estimate for harbor of refuge at Ludington, Mich., **85**, 2073. (Lt. Cols. Poe and Barlow and Capt. Lockwood.)

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1867–68. Reports, **67**, 114; **68**, 131.

Capt. F. U. Farquhar, 1869–72. Reports, **69**, 88; **70**, 131; **71**, 137; **72**, 178.

Capt. S. M. Mansfield, 1872–79. Reports, **72**, 186; **73**, 265; **74**, 178; **75**, 247; **76**, ii, 474; **77**, ii, 906; **78**, 1203; **79**, 1606.

Maj. F. Harwood, 1880–82. Reports, **80**, 2013; **81**, 2208; **82**, 2293.

Maj. D. P. Heap, 1882–83. Report, **82**, 2290.

Capt. D. W. Lockwood, 1883–87. Reports, **83**, 1815; **84**, 1977; **85**, 2072, 2091; **86**, 1761; **87**, 2184.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1905.

Maj. W. Ludlow, 1889–93. Reports, **89**, 2173; **90**, 2621, 2628; **91**, 2682; **92**, 2326; **93**, 2895.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94**, 2220; **95**, 2806; **96**, 2703, **98**, 2522.

Capt. C. McD. Townsend, 1897. Reports, **97**, 2930, 2951.

Capt. C. Harding, 1899–. Reports, **99**, 2936; **1900**, 3916.

ASSISTANT. Capt. A. Mackenzie. Report, **68**, 131.

**Estimates.** (See *Plans* and *Projects*.)

By Maj. Wheeler, $270,682.16, **67**, 25, 114; **68**, 35, 131; **74**, 178, 179; **76**, ii, 474, 475; **77**, 906. For new cut, $269,136.49, **67**, 25; **74**, 178; **76**, ii, 475. For removal of old south slab pier and construction of revetment, $52,000, **69**, 88; **70**, 40, 131; **74**, 178. Modified, $35,440, **71**, 138.

By Capt. Mansfield, pier extension, $40,000, **72**, 36, 187. Additional, $36,000, **75**, 247, 248. For completion, $17,602.07, **79**, 162, 1607.

**Operations.**

**1867–68.** North pier, 64 l. f. crib built; south pier, 544 l. f. crib built; 8,900 c. y. dredged; damages to piers, **68**, 35, 131, 132; **74**, 178; **76** ii, 476.

**1868–69.** North pier, 128 l. f. crib built; south pier, 25 l. f. crib built; 544 l. f. superstructure, **69**, 30, 88; **74**, 178; **76**, ii, 476.

**1869–70.** North pier, 384 l. f. crib built; superstructure built, **70**, 40, 131; **74**, 178; **76**, ii, 476.

**1870–71.** 384 f. superstructure; both piers reballasted, **71**, 38, 137; **74**, 178; **76**, ii, 476.

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[a] Contract extended, **79**. 1606.

**LUDINGTON (Pere Marquette) HARBOR, MICH.**—Continued.

**1871–72.** North pier, 30 l. f. crib built; south pier, 135 l. f. pile revetment built; dredging by U. S. dredge; removal of old south pier begun, **72**, 36, 178; **74**, 178; **76**, ii, 477.

**1872–73.** Removal of old south pier, dredging, and construction of revetment, **73**, 37, 265; **74**, 178; **76**, ii, 477.

**1873–74.** South pier, 250 l. f. crib built; 6,520 c. y. dredged; 1 crib lost from south pier, **74**, 43, 178, 179; **76**, ii, 477.

**1874–75.** South pier, 50 l. f. crib and 560 l. f. pile revetment built; 38,351 c. y. dredged; 300 f. superstructure, slab pier removed, crib replaced, and dredging, **75**, 47, 247, 248.

**1875–76.** North pier, 100 l. f. crib built; 31,750 c. y. dredged; repairs to south pier head and dredging, **76**, 100, ii, 474,

**1876–77.** Repairs, **77**, 106, 906.

**1877–78.** South pier, 100 l. f. crib built; 6,000 c. y. dredged; repairs to both piers, **78**, 121, 1203.

**1878–79.** North pier, 100 l. f. crib built; south pier, 50 l. f. crib built; 18,720 c. y. dredged; repairs to dredge, **79**, 162, 1606.

**1879–80.** 100 l. f. crib work placed in pier extension, **80**, 2013.

**1880–81.** 122 cords stone used in refilling south pier; piers and revetments made sand tight; south pier extended 50 f., **81**, 2208.

**1881–82.** 50 by 30 f. crib sunk in prolongation of south pier; 150 l. f. superstructure built; 5,000 c. y. sand dredged from bar at mouth of channel, **82**, 2290.

**1882–83.** Outer end of south pier repaired; 100 l. f. superstructure built; 4,020 c. y. dredged from channel, **83**, 1815.

**1883–84.** 10,338 c. y. dredged from between piers; north side of south pier repaired, **84**, 1977.

**1884–85.** South pier extended 50 f. and part of the superstructure for same built, **85**, 2073.

**1885–86.** 9,990 c. y. dredged from between piers, **86**, 1761.

**1887–88.** 3,780 c. y. dredged from the channel, **88**, 1906.

**1888–89.** 4 cribs for the north pier begun, **89**, 2174.

**1889–90.** 500 l. f. of crib work added to north pier; 17,018 c. y. sand dredged; 400 l. f. of crib work added to north pier; 592 l. f. of sand fence built upon south beach, **90**, 2621.

**1890–91.** Repairs to north pier, **91**, 2683.

**1891–92.** 19,397 c. y. sand dredged by hired labor, **92**, 2326.

**1892–93.** Gauge readings made, **93**, 2896.

**1893–94.** 13,802 c. y. dredged and repairs made to south pier, **94**, 2221.

**1894–95.** 26,489 c. y. dredged, **95**, 2806.

**1895–96.** General repairs made and 7,812 c. y. dredged, **96**, 2704.

**1896–97.** 58,827 c. y. dredged and parts of north and south piers reconstructed, **97**, 2931.

**1897–98.** 510 l. f. old piers rebuilt, **98**, 2522.

**1898–99.** 18,262 c. y. dredged, **99**, 2936.

**1899–1900.** 23,026 c. y. dredged; pier repairs in progress (drawings, **99**, 2938), **1900**, 3916.

**Physical characteristics.**

Serious blocking of harbor mouth, **73**, 265.

Advance of north shore line, **73**, 265.

Similarity between Ludington and Frankfort harbors, **76**, ii, 474.

Description of, **97**, 2952.

Shoaling, **99**, 2937, **1900**, 3916.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. J. B. Wheeler, new cut at a point about a mile distant from the old entrance, **67**, 25.

By Capt. Lockwood, harbor of refuge through the construction of an outer breakwater; estimate $861,260, **85**, 2091, 2029.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Wheeler, 1866, 2 parallel crib piers 200 f. apart, extending into the lake 450 f. on the north side and 640 f. on the south side; repairs to old north slab pier; removal of old south slab pier; close piling in south side of crib and dredging to 12 f., **67**, 25, 114; **68**, 131; **69**, 88; **70**, 40, 131; **74**, 178; **76**, ii, 474. Estimated cost amended in 1879, $213,787, **80**, 2014; **85**, 2074. Whole amount appropriated from 1867 to 1884, inclusive, $263,185, **85**, 2074.

By Capt. S. M. Mansfield, extension, by crib work, of both piers to 12 f. of water, 250 f. each, **72**, 36, 187; **76**, ii, 477. For extension of both piers 150 l. f., **75**, 47. For pier extension to 16 f. of water, **79**, 162, 1607.

By Capt. Lockwood, 1884, forming harbor of refuge by widening to 400 f. the present entrance to Pere Marquette Lake by construction of a new south pier and dredging channel to 18 f.; estimate $419,185, **84**, 2001; **85**, 2093. Recommended by Board of Engineers, 1884, **85**, 2093.

In 1880 the project was amended by Maj. Ludlow, with the approval of the Chief of Engineers, to retain the south pier in its position as indicated in the project of 1866, **90**, 2622.

By Capt. Townsend, 1897, 700-f. exten-

## LUDINGTON (Pere Marquette) HARBOR, MICH.—Continued.

sion of north pier, and 300-f. extension of south pier, dredging and repairs; estimate, $210,000, **97**, 2952; **99**, 2938.

**Surveys.**
Under direction of Maj. W. F. Raynolds, 1866, **67**, 114.
Under direction of Maj. J. B. Wheeler, 1868, **76**, ii, 476.
Under direction of Capt. F. U. Farquhar, 1869–70–71, **76**, ii, 476; **73**, 265.
Memoranda of soundings, **76**, ii, 475, 476, 477.
For harbor of refuge, **82**, 2290.
Minor surveys made, 1894, by Lt. Col. Lydecker, **94**, 2221.
Survey of the harbor ordered by act of June 3, 1896, made by Capt. Townsend, 1897 (see *Projects*), **97**, 2951.

MAPS. **82**, 2292; **84**, 1977; **90**, 2630.

DRAWINGS. (See *Operations, 1900.*)

## LUMBER RIVER, N. C. AND S. C.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $5,000, | **88**, | 128. |
| 1890, | 5,000, | **90**, | 1199. |
| 1892, | 5,000, | **92**, | 1200. |
| 1894, | 4,000, | **95**, | 1396. |
| Total, | 19,000 | | |

**Commerce.**
Description of, **93**, 1470; **94**, 1075; **95**, 1397; **96**, 1157.
In 1892–93 the aggregate tonnage of freight moved on the river was 7,154 t., **93**, 1469; in 1893–94, 10,550 t., **94**, 1072; 1894–95, 19,131 t., **95**, 1396; in 1895–96, 61,650 t., **96**, 1156.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **87**, 139; **88**, 128; **89**, 150; **90**, 138; **91**, 171; **92**, 170; **93**, 184; **94**, 169; **95**, 193; **96**, 172; **97**, 214.
ENGINEERS IN CHARGE:
Capt. W. H. Bixby, 1887. Report, **87**, 1102.
Capt. F. V. Abbot, 1888–97. Reports, **89**, 1158, 2795; **90**, 1198; **91**, 1445; **92**, 1199; **93**, 1468; **94**, 1071; **95**, 1395; **96**, 1155; **97**, 1442.
ASSISTANT. R. Whitford. Reports, **89**, 1159; **90**, 1199; **91**, 1447; **92**, 1200; **93**, 1469; **94**, 1073; **95**, 1397; **96**, 1156; **97**, 1444.

**Obstructions.**
Bridges of Carolina Central R. R., W. and C. R. R., and low bridge at Nicholas, **89**, 2795.

**Operations.**
**1890–91.** 2,434 snags and logs cleared from the channel, and 3,472 trees cut from the banks, **91**, 1447.
**1891–92.** River cleared of snags and similar obstructions from the mouth to 50 miles above, **92**, 1199.
**1892–93.** About 3,000 snags and other obstructions removed from channel and banks, **93**, 1469.
**1893–94.** About 50 snags and other obstructions removed, **94**, 1073.
**1894–95.** About 400 snags and other obstructions removed, **95**, 1397.
**1896–97.** About 1,000 snags and other obstructions removed, **97**, 1444.

**Physical characteristics.**
Description of, **87**, 1103.

**Projects.**
By Capt. Bixby, 1887, clearing the river of obstructions so as to permit of a 4 to 6 foot draft steam navigation from its mouth to Lumberton; estimate $35,000, **87**, 1106; **92**, 1199.

**Surveys.**
Ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Bixby, **87**, 1104.

MAPS. **90**, 1198.

## LUMBERTON BRANCH. (See *Rancocas River, N. J.*)

## LYNCH RIVER, S. C. (See *Clark River.*)

**Commerce.**
Description of, **93**, 1533; **1900**, 1878.
A considerable trade existing in 1892–93. Annual shipments valued at $50,000 would probably be made if the stream were improved. **93**, 1533.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 125; **81**, 168; **93**, 190; **99**, 255; **1900**, 291.
ENGINEERS IN CHARGE:
Capt. C. B. Phillips. Report, **81**, 1038.
Capt. F. V. Abbot, 1883. Report, **93**, 1532.
Maj. E. H. Ruffner, 1900. Report, **1900**, 1877, 1879.
ASSISTANTS:
J. P. Darling. Report, **81**, 1039.
R. Whitford. Report, **1900**, 1878, 1880.

**LYNCH RIVER, S. C.**—Continued.

**Obstructions.**
The stream is crossed by 3 wooden bridges which could easily be provided with draw spans, **93**, 1533.
In 1900 there were 5 county bridges, without draws, crossing the river, **1900**, 1881.

**Physical characteristics.**
Description of, **81**, 1039; **93**, 1533; **1900**, 1879.

**Plans.**
By Capt. Phillips, 1881, improvement between the Wilmington, Columbia & Augusta R. R. bridge and its mouth by removal of snags, logs, and fallen trees; estimate, $45,000, **81**, 1039, 1040.

**Projects.**
Maj. Ruffner estimated, 1899, it would cost $68,750 to make an improvement, **1900**, 1879.

**Surveys.**
Ordered by act of June 14, 1880; made, 1880, under direction of Capt. Phillips, **81**, 1038.
Examination ordered by act of July 13, 1892; made by Capt. Abbot, 1892 (report favorable), **93**, 1533.
Examination and survey of river from railroad bridge at Effingham to its mouth at junction of Great Pedee River, with view to procure a 3-f. depth, m. l. w., ordered by act of Mar. 3, 1899; made, 1899, under direction of Maj. Ruffner (report favorable), (see *Projects*), **1900**, 1877, 1879.

**LYNN HARBOR, MASS.**[a] (See *Saugus River, Mass.*)

**Appropriations.**
1882, $60,000, **83**, 461.
1886, 6,000, **86**, 578.
1888, 10,000, **88**, 446.
1890, 15,000, **90**, 496.
1892, 10,000, **92**, 573.
1894, 7,500, **95**, 617.
1896, 20,000, **96**, 601.
Total, 128,500

**Commerce.**
Important, **83**, 462.

**Contracts.**
**1884.** Moore & Wright, dredging, 23½ cents per c. y., **84**, 522.
**1886.** A. R. Wright, dredging, 21½ cents per c. y., **87**, 510.
**1888.** Bay State Dredging Co., dredging, 29 cents per c. y. in main channel, 45 cents per c. y. in Saugus River Channel; removal of bowlders over 3 t. each, $10 per c. y., **89**, 570.
**1890.** New England Dredging Co., dredging, 18 cents per c. y., **91**, 643.
**1893.** Boynton Bros., dredging 41,322 c. y., at 33⅞ cents; removal of bowlders over 3 t, $10, **93**, 760.
**1894.** A. B. Martin, dredging 32,608 c. y., at 23 cents per c. y., **95**, 617.
**1897.** A. B. Martin, dredging, 21⅞ cents per c. y. ($8,750); removal of bowlders over 3 t. each, $8, **97**, 840.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **31**, 77; **82**, 77; **83**, 71; **84**, 77, 523; **85**, 65; **86**, 65, **87**, 26; **88**, 26; **89**, 37; **90**, 31; **91**, 39; **92**, 45; **93**, 44; **94**, 42; **95**, 45; **96**, 46, **97**, 52, 65; **98**, 59, **99**, 69; **1900**, 78, 94.
BOARD OF ENGINEERS. Convened at New York Apr. 10, 1884, to report upon Col. Thom's project for improvement of Lynn Harbor. Report, **84**, 524. (Lt. Cols. Abbot and Comstock.)
ENGINEERS IN CHARGE:
Col. G. Thom, 1881. Report, **82**, 544.
Maj. C. W. Raymond, 1883–86. Reports, **83**, 460; **84**, 520, 531, 549; **85**, 516.
Lt. Col. G. L. Gillespie, 1886–89. Reports, **86**, 577; **87**, 508; **88**, 445.
Lt. Col. S. M. Mansfield, 1889–98. Reports, **89**, 568; **90**, 494; **91**, 641; **92**, 572; **93**, 758; **94**, 545; **95**, 615; **96**, 599; **97**, 839, 872; **98**, 860.
Col. C. R. Suter, 1899–. Reports, **99**, 1070; **1900**, 1189.
ASSISTANT. H. F. Bothfield. Report, **84**, 531.

**Operations.**[b]
**1884–85.** 170,445 c. y. dredged from the lower and upper channels, **85**, 517.
**1886–87.** 50,089 c. y. dredged from inner channel, **87**, 509.
**1889–90.** 25,571 c. y. dredged, **90**, 495.
**1891–92.** 40,000 c. y. dredged from the harbor basin, **92**, 573.
**1892–93.** 4,583 c. y. dredged, **93**, 759.
**1893–94.** About 35,000 c. y. dredged, **94**, 546.
**1894–95.** 7,020 c. y. dredged, **95**, 616.
**1895–96.** About 25,000 c. y. dredged, **96**, 600.
**1897–98.** About 54,000 c. y. dredged, **98**, 861.

**Physical characteristics.**
Prevailing winds and tidal data, **84**, 536, 537.

[a] Survey—Report Sept. 20, 1837, estimate, $30,000. (H. Doc. No. 482, 55th Cong., 2d sess.)
[b] History of harbor, **84**, 538.

**LYNN HARBOR, MASS.**—Continued.

Current observations, **84**, 546.
Description of, **97**, 873.

**Plans.**
By Col. Thom, improving harbor by means of two rubble breakwaters, **84**, 524, 529.

**Projects.**
By Board of Engineers, 1884, formation of a channel 200 f. wide and 10 f. deep at m. l. w. from a point near the White Rocks to deep water opposite Little Nahant, and from deep water opposite Sand Point to Lynn Harbor line; the upper part of the channel to be maintained by occasional dredging, the lower part by a training wall joining the land at Little Nahant; estimate, $145,000, **84**, 521, 528. Cost revised to $157,000, **85**, 517; **87**, 509.
In Sept., 1888, the project was modified by extending the inner channel 400 f. inside the harbor line and making at its inner end an anchorage basin 500 by 300 f. and 10 f. deep at m. l. w.; revised cost of project, $182,000, **89**, 37; **92**, 573.
By Lt. Col. Mansfield, 1892, for a channel 150 f. wide, 8 f. deep, at entrance to western channel, and for widening inner channel of main harbor to full projected dimensions as far as available funds would permit, **93**, 759.
Col. Mansfield, 1897, estimated it would cost $441,813.07 for channel 300 f. wide and 15 f. deep at m. l. w., **97**, 872.

**Surveys.**
Ordered by act of Mar. 3, 1881; made, 1881, under direction of Col. Thom, **82**, 544.
Of harbor, 1885, **85**, 517.
Of the improved channels made, 1888, under direction of Lt. Col. Gillespie, **88**, 446.
Survey ordered by act of June 3, 1896; made by Lt. Col. Mansfield, 1897 (report partly favorable) — (see *Projects*), **97**, 872.

MAPS.
**84**, 532.
Of upper channel, **86**, 578.

**LYNN HAVEN BAY, VA. (Harbor of Refuge.)**

**Engineers.**
CHIEF OF ENGINEERS. Reports, **91**, 146; **92**, 147.
ENGINEER IN CHARGE. Lt. Col. P. C. Hains, 1892. Report, **92**, 1076.

**Physical characteristics.**
Description of, near Cape Henry at the foot of Chesapeake Bay, Va., **92**, 1077.

**Plans.**
By Lt. Col. Hains, 1891, for a breakwater 4,500 f. long, of concrete blocks laid close and bonded together; estimate, $1,555,538, **92**, 1079.

**Survey.**
Survey for harbor of refuge ordered by act of Mar. 3, 1891, made, 1891, under direction of Lt. Col. Hains, **92**, 1076.

**LYNN HAVEN BAY, to Eastern Branch of Elizabeth River, Va. (Waterway.)**

**Engineers.**
CHIEF OF ENGINEERS. Reports, **91**, 153, 1310.
ENGINEERS IN CHARGE:
Lt. G. J. Fiebeger, 1890. Report, **91**, 1310.

**Physical characteristics.**
Description of, **91**, 1313.

**Survey.**
Examination ordered by act of Sept. 19, 1890, made, 1890, under direction of Lt. Fiebeger (report unfavorable), **91**, 1310.

**LYNN HAVEN, LINK HORN, AND BROAD BAYS, VA.**

**Commerce.**
Oyster industry important, **80**, 900.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **79**, 95; **80**, 125.
ENGINEER IN CHARGE. Capt. C. B. Phillips, 1880. Report, **80**, 900.
ASSISTANT. F. W. Frost, **80**, 900.

**Physical characteristics.**
The bays might be available as links in a line of water communication between Chesapeake Bay and the sounds of North Carolina, **80**, 900.

**Survey.**
Survey ordered by act of Mar. 3, 1879, made, 1880, under direction of Capt. Phillips (report unfavorable), **80**, 900.

## LYONS CREEK, VA.

**Commerce.**
Merchandise, brick, and peanuts, with a total value of $28,000, were shipped in 1894. Limited interests involved apparently would not justify an expenditure by the Government for an improvement of navigation. **95**, 1298.

**Engineers.**
Chief of Engineers. Report, **95**, 177.
Engineer in Charge. Capt. T. L. Casey, 1894. Report, **95**, 1297.

**Physical characteristics.**
Description of, **95**, 1297.

**Survey.**
Examination ordered by act of Aug. 17, 1894, made by Capt. Casey, 1894 (report unfavorable), **95**, 1297.

## M'CARGOES COVE, ISLE ROYALE, LAKE SUPERIOR, MICH.

**Engineers.**
Chief of Engineers. Report, **76**, 93.
Engineer in Charge. Maj. C. B. Comstock, 1876. Report, **76**, ii, 320.

**Plans.**
By Maj. Comstock, 1876, for excavating part of rocky ledge obstructing entrance, to a depth of 15 f. at l. w.; estimate, $45,000, **76**, ii, 320.

**Surveys.**
This locality included in the Lake Survey, 1867, **76**, ii, 320.

## MACHIAS RIVER, ME.

**Appropriations.**
1873, $12,000, **73**, 1054.
1874, 10,000, **74**, 105.
1875, 10,000, **75**, 112.

Total, 32,000

**Commerce.**
Value of lumber and stone shipped annually, **95**, 586; **97**, 810.

**Contracts.**
**1873.** E. M. Lee Prohon, removing Middle Rock, $6.75 per c. y., **73**, 1054.
**1874.** Curtis, Fobes & Co., dredging, 60 cents per c. y., **75**, ii, 384.
**1875.** A. R. Wright, dredging, 45 cents per c. y., **75**, ii, 384.

**Engineers.**
Chief of Engineers. Reports, **73**, 94; **74**, 104; **75**, 112; **76**, 38; **77**, 32; **95**, 38; **97**, 43.
Engineers in Charge:
Lt. Col. G. Thom, 1872–77. Reports, **73**, 1053, 1102; **74**, ii, 295; **75**, ii, 383; **76**, 152; **77**, 154.
Lt. Col. D. P. Heap, 1895. Report, **95**, 584.
Maj. R. L. Hoxie, 1897. Report, **97**, 809.
Assistants:
S. Haagensen, **73**, 1102. Report, **73**, 1104.
W. F. Robinson. Report **97**, 810.

**Operations.**
**1873–74.** Removal of Middle Rock to average depth of one-half f. below m. l. w., **74**, 104, ii, 296.
**1874–75.** Removal of 6,100 c. y. by dredging, **75**, ii, 384.
**1875–76.** A channel 850 f. long by 100 f. wide dredged through shoal above Middle Ground, and 800 f. long by 125 f. wide through upper part of Middle Ground; removal of shoal near drawbridge, **76**, 38.
**1876–77.** Completion of project; total amount of rock removed, 1,350 c. y.; material dredged, 33,000 c. y., **77**, 33.

**Physical characteristics.**
Description, **73**, 1053, 1103, 1104; **74**, ii, 296; **95**, 585.
List of obstructions, **73**, 1053, 1103, 1104; **74**, ii, 296.

**Projects.**
By Lt. Col. Thom, 1873, removal of obstructions to obtain a channel 150 f. by 6 f. deep at m. l. w. to the wharves at Machias, 3 miles; estimate, $48,000, **73**, 74, 1053, 1154, 1103, 1104; **74**, 104, ii, 296. Effect of improvement but temporary, unless the river be protected, **74**, ii, 297; **75**, 112.
Original project modified, 1876, to channel 100 f. wide, and removal of Middle Rock to one-half f. below m. l. w., at estimated cost of $32,000, **76**, 153.
In 1895 Maj. Heap estimated improvement would cost $50,244.25, **95**, 586.

**Surveys.**
Survey by S. Haagensen, 1872, **73**, 1053, 1104. Bench marks, **73**, 1105.
Survey ordered by act of Aug. 17, 1894, made, 1895, by Maj. Heap (report favorable), **95**, 584.
Survey ordered by act of June 3, 1896, from Machias to Machiasport, made, 1897, by Lt. Col. Damrell (report favorable), **97**, 809.

## MACHODOC (LOWER) CREEK, VA.

**Appropriations.**
1892, $3,000, **93**, 1290.
1894, 3,000, **95**, 1233.
1896, 1,500, **96**, 1045.
1899, 1,500, **99**, 1425.

Total, 9,000

**Commerce.**

Benefit to commerce largely prospective, **96**, 1045. Steamer from Washington making weekly trips to a newly-established wharf in 1897, **97**, 1330.

**Contracts.**

**1893.** F. L. Somers, dredging, 21 cents per c. y. ($2,394), **93**, 1291.

**1894.** T. P. Morgan, dredging, 23 cents per c. y. ($2,760), **95**, 1231. (Annulled in 1895 on account of failure of contractor, **96**, 1044.)

**1896.** C. T. Caler, dredging, 22½ cents per c. y. ($2,362.50), **96**, 1042.

**1897.** Baltimore Dredging Co., dredging, 22 cents per c. y. ($1,110), **98**, 1192.

**1899.** J. L. Mills, dredging, 16¾ cents per c. y. ($837.50), **1900**, 1710.

**Engineers.**

Chief of Engineers. Reports, **89**, 135; **93**, 152; **94**, 141; **95**, 162; **96**, 146; **97**, 181; **98**, 184; **99**, 212; **1900**, 242.

Engineers in Charge:

Col. W. P. Craighill, 1889. Report, **89**, 1037.

Maj. C. E. L. B. Davis, 1892–95. Reports, **93**, 1289; **94**, 950; **95**, 1231.

Maj. C. J. Allen, 1896. Reports, **96**, 1043; (Lt. Col.) **97**, 1329; **98**, 1197; **99**, 1424; **1900**, 1714.

**Operations.**

**1892–93.** Dredging in progress, **93**, 1290.

**1893–94.** 11,691 c. y. dredged, **94**, 952.

**1895–96.** 10,398 c. y. dredged, **96**, 1044.

**1897–98.** 4,957 c. y. dredged, **98**, 1198.

**1899–1900.** 6,240 c. y. dredged, **1900**, 1714.

**Physical characteristics.**

Description of, **89**, 1037.

Description of, and of original condition, **97**, 1329.

**Projects.**

By Maj. Davis, 1892, dredging channel 9 f. deep and 150 f. wide through the bar at the Narrows; estimate, $15,000, **93**, 152; available funds to be used to obtain a channel 6 f. deep and 100 f. or more wide until Congress should appropriate more money for the improvement, **93**, 1290.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of S. T. Abert (Col. Craighill's report unfavorable), **89**, 1037.

Survey made, 1892, by Maj. Davis, **93**, 1290.

Examination made, 1897, by Lt. Col. Allen, **97**, 133, and in 1899, **99**, 1424.

Maps, **94**, 952.

## MACHODOC (UPPER) CREEK, VA. (See *Upper Machodoc.*)

**Engineers.**

Chief of Engineers. Reports, **81**, 158; **82**, 154.

Engineer in Charge. S. T. Abert, U. S. agent. Report, **82**, 1067.

**Plans.**

By S. T. Abert, 1882, 7½ f. channel 75 f. wide, Potomac River to Clannahan's wharf, $35,771; for a similar channel from Potomac River to Milford Landing, $53,769, **82**, 1067, 1068.

**Survey.**

Ordered by act of Mar. 3, 1881, made, 1882, under direction of S. T. Abert, **82**, 1067.

## MACK ARCH, OREG. (See *Pacific Coast, Harbor of refuge.*)

**Engineers.**

Chief of Engineers. Report, **77**, 1053.

Board of Engineers. For the Pacific coast met Aug., 1876, to "examine the harbors of Mendocino, Humboldt Bay, Trinidad, and Crescent City, Cal., with a view of establishing a breakwater and harbor of refuge." The board reported that a harbor at Mack Arch, Oreg., would be small, but tolerably secure. Report, **77**, 1054. (Lt. Cols. Williamson, Alexander, and Stewart, and Maj. Mendell.)

**Estimates.**

By Board of Engineers, breakwater, $5,748,875, **77**, 1059.

## MACKEYS CREEK, N. C.

**Appropriation.**
1890, $15,000, **91**, 1340.

**Commerce.**
Not unimportant, **73**, 858.
Commercial interests, **89**, 1138.

**Contracts.**
**1891.** Alabama Dredging Jetty & Co., dredging, 26 cents per c. y., **91**, 1340.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **72**, 74; **73**, 78; **89**, 149; **91**, 155; **92**, 156; **93**, 169; **94**, 155; **95**, 176.
ENGINEERS IN CHARGE:
Maj. W. P. Craighill, 1872–73. Report, **73**, 858.
Capt. W. H. Bixby, 1888–92. Reports, **89**, 1137; **91**, 1339.
Maj. W. S. Stanton, 1892–94. Reports, **92**, 1113; **93**, 1357; **94**, 995.
Capt T. L. Casey, 1895. Report, **95**, 1294.
ASSISTANT. G. H. Elliott. Report, **73**, 857.

**Operations.**
**1890–91.** Dredging in progress under contract, **91**, 1339.
**1891–92.** 41,359 c. y. dredged, **92**, 1114.
**1892–93.** 5,851 c. y. dredged, and an old wreck removed. Project completed. **93**, 1358.

**Physical characteristics.**
Described, **73**, 858; **89**, 1137.

**Plans.** (See *Projects.*)
By G. H. Elliott, and concurred in by Maj. Craighill, removal of wreck, and dredging channel 60 f. wide by 7 f. deep, mouth to the 7 f. curve in Albemarle Sound; estimate, $4,290, **73**, 858; increased by Maj. Craighill to $5,000, **73**, 855.

**Projects.** (See *Plans.*)
By Capt. Bixby, 1889, creek entrance, excavation of a straight channel of 100 f. width and 9 f. depth at low water, mouth of the creek, across the bar, to Albemarle Sound; estimate, $15,000, **89**, 1139; **91**, 1339.

**Surveys.**
Under the direction of Maj. Craighill by G. H. Elliott, 1872. Report, **73**, 854, 857.
Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Capt. Bixby, **89**, 1137.
Survey made, 1893, by Maj. Stanton, **94**, 975.
MAPS. **91**, 1340.

## MACKINAC HARBOR, MICH.

**Commerce.**
Not unimportant, **71**, 160.
Interests of, require protection, **80**, 2056.
Decadence of, **87**, 2272.
Description of, local and passenger traffic much larger in 1899 than ten years earlier, **1900**, 4009.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **78**, 42; **79**, 170; **80**, 221; **85**, 332; **87**, 294; **1900**, 587.
ENGINEERS IN CHARGE:
Capt. F. U. Farquhar, 1870. Report, **71**, 160.
Maj. F. Harwood, 1879–80. Reports, **79**, 170; **80**, 2055.
Lt. Col. O. M. Poe, 1885–87. Reports, **85**, 2180; **87**, 2271.
Lt. Col. G. J. Lydecker, 1899–1900. Report, **1900**, 4008.

**Physical characteristics.**
Recession of beaches, **80**, 2055.
Description of, **71**, 160; **1900**, 4009.
The harbor on the south shore of Mackinac Island, **1900**, 4009.

**Plans.**
By Capt. Farquhar, 1870, breakwater 4,000 f. long by 35 f. wide by 30 f. high; estimate, $761,333.76, **71**, 160, 161. "Not the slightest necessity for a harbor of refuge at this point. At present there is not local importance enough to justify any expenditure of public funds in building a harbor of any kind."—Extract from Capt. Farquhar's report. **71**, 160.
By Maj. Harwood, 1880, converging piers from Mission and Biddles points; estimate, $125,000 to $200,000, **80**, 2056, 2057.
In 1884 Col. Poe reported the cost of a breakwater to afford a harbor of refuge would not be less than $1,500,000, and that the commercial requirements of the locality would not justify such expenditure, **85**, 2181.
Lt. Col. Poe, examination, 1886, repeats Maj. Harwood's estimate, $125,000, as cost of breakwater located off Biddles Point, **87**, 2272.
Lt. Col. Lydecker, 1900, estimated it would cost $80,000 to construct two breakwaters, **1900**, 4008.

**Surveys.**
Examination made by Capt. Farquhar, 1870. Report, **71**, 160.
Survey in progress, under direction of Maj. Harwood, **79**, 160.
Ordered by act of Mar. 3, 1879, **80**, 221; made under direction of Maj. Harwood, 1880, **80**, 2055.

## MACKINAC HARBOR, MICH.—Continued.

Ordered by act of July 5, 1884, made, under direction of Lt. Col. Poe, **85**, 2180.

Examination of Biddles Point with view to breakwater, ordered by act of Aug. 5, 1886, made, under direction of Lt. Col. Poe, **87**, 2271.

Examination and survey with a view to constructing a harbor of refuge by means of two breakwaters, ordered by act of Mar. 3, 1899, made, 1899–1900, by Lt. Col. Lydecker (report favorable) (see *Projects*), **1900**, 4008.

## MACON. (See *Georgia Canal; Tensas River, La.*)

## MACON BAYOU, LA. (See also *Tensas River, La.*)

**Appropriations.**

Act of July 5, 1884, united improvement with that of Tensas River, La., **84**, 400; **85**, 1504.

**Commerce.**

Important, **81**, 1463.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 213; **85**, 236; **86**, 232; **87**, 197.

ENGINEERS IN CHARGE:

Maj. W. H. H. Benyaurd. Report, **81**, 1462.

Maj. A. M. Miller, 1885. Report, **85**, 1504.

Capt. E. Bergland, 1886. Report, **86**, 1355.

Capt. J. H. Willard, 1887. Report, **87**, 1463.

ASSISTANT. F. S. Burrows. Report, **81**, 1463.

**Physical characteristics.**

Described, **81**, 1463.

**Operations.**

**1886–87.** Obstructions removed from Floyds to junction of bayou with Tensas River, **87**, 1464.

**Plans.** (See *Project.*)

By Maj. Benyaurd, 1880, clearing the bayou of logs and similar obstructions from its head to junction with Tensas River; estimate, $17,000, **81**, 1463.

**Projects.** (See *Plans.*)

By act of July 5, 1884, improvement of Bayou Macon was united with that of Tensas River, La., by the adoption of Maj. Benyaurd's plan of 1880 for the removal of logs, trees, and similar obstructions, Bayou Macon from Floyds to its junction with Tensas River, 130 miles; estimate, $17,000, **81**, 1463; **84**, 400; **85**, 1504.

**Surveys.**

Examination ordered by act of June 14, 1880, made, under the direction of Maj. Benyaurd, 1880, **81**, 1462.

## MADISON HARBOR, CONN.

**Commerce.**

Necessity for breakwater, **82**, 629; **84**, 685.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 97; **82**, 97; **84**, 100.

ENGINEER IN CHARGE. Maj. J. W. Barlow. Reports, **82**, 671; **84**, 685.

ASSISTANT. H. N. Babcock. Report, **82**, 627.

**Plans.**

By Maj. Barlow, 1882, for breakwater covering the landing at Milford; estimate, $285,000, **82**, 627.

**Surveys.**

Ordered by acts of Mar. 3, 1881, and Aug. 2, 1882, made, under direction of Maj. Barlow, **82**, 627; **84**, 685.

## MAHON RIVER, DEL.

**Commerce.**

Description of, **95**, 1151.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **89**, 112; **95**, 150.

ENGINEER IN CHARGE. Maj. Smith, U. S. agent, 1889–95. Reports, **89**, 908; **95**, 1149.

ASSISTANT. A. Stierle. Reports, **89**, 909; **95**, 1150.

**Physical characteristics.**

Description of, **89**, 909; **95**, 1150.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Smith (report unfavorable), **89**, 908.

Examination ordered by act of Aug. 17, 1894, made, under the direction of Maj. Smith in 1894 (report unfavorable), **95**, 1149.

## MAILBOAT SLOUGH, WASH. (See *Willapa River.*)

## MALDEN AND MYSTIC RIVERS, MASS. (See *Mystic River, Mass.*)

**Appropriations.**

| | | |
|---|---|---|
| 1882, | [a]$10,000, | **83**, 465. |
| 1892, | 10,000, | **92**, 763. |
| 1894, | 10,000, | **95**, 620. |
| 1896, | 10,000, | **96**, 603. |
| 1899, | 5,000, | **99**, 1072. |
| Total, | 45,000 | |

**Contracts.**

**1883.** R. Hamilton, jr., dredging, 24½ cents per c. y., **83**, 465.

**1894.** C. H. Souther, dredging 75,981 c. y., 23¾ cents per c. y., **95**, 620.

**1896.** A. B. Martin, dredging 28,985 c. y., 34½ cents per c. y.; removal of bowlders over 3 t., $5 per c. y., **97**, 842.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, 72; **81**, 77; **83**, 72; **84**, 78; **85**, 66; **86**, 66; **87**, 28; **88**, 29; **89**, 43; **91**, 63; **93**, 45; **94**, 43; **95**, 46; **96**, 47; **97**, 53; **98**, 60; **99**, 70; **1900**, 79.

ENGINEERS IN CHARGE:

Col. G. Thom, 1880–83. Report, **81**, 532.

Maj. C. W. Raymond, 1883–86. Reports, **83**, 464; **84**, 551; **85**, 519.

Lt. Col. G. L. Gillespie, 1886–88. Reports, **86**, 579; **87**, 520; **88**, 456.

Lt. Col. S. M. Mansfield, 1888–98. Reports, **89**, 594; **91**, 672; **93**, 762; **94**, 547; **95**, 618; **96**, 601; **97**, 841; **98**, 862.

Col. C. R. Suter, 1899–1900. Reports, **99**, 1071; **1900**, 1191.

ASSISTANTS:

S. Haagensen. Report, **81**, 533.

T. T. H. Harwood. Report, **91**, 675.

**Operations.**

**1882–83.** 4,420 c. y. dredged from channel below Malden River drawbridge, **83**, 464.

**1883–84.** 30,811 c. y. dredged, **84**, 551.

**1894–96.** 5,000 l. f. of river dredged, **95**, 618; 75,229 c. y. dredged, **96**, 602.

**1896–97.** 1,864 c. y. dredged, **97**, 842.

**1897–98.** About 26,000 c. y. dredged, **98**, 863.

**1899–1900.** Shoal in Malden River removed, **1900**, 1192.

**Physical characteristics.**

Description of, **81**, 532.

Description of, Mystic River, **91**, 672.

**Plans.** (See *Projects.*)

In 1888, after examination, Lt. Col. Gillespie reported that the cost of straightening and deepening the existing channel to admit of 12 f. at high-water range of tides (estimate, $37,000) was incommensurate with the commercial interests, **89**, 594.

**Projects.** (See *Plans.*)

The project originally proposed by Lt. Thom, in 1880, was to excavate a channel 100 f. wide and 12 f. deep at m. h. w. up to the second bridge in Malden, with 2 cut-offs, one east of the island near the mouth of the river, and one through the marsh one-half mile above; estimate, $40,000. This project was modified in 1882, when it was proposed to make the natural channel of the river 100 f. wide, 12 f. deep at m. h. w., to the first bridge in Malden, thence to the second bridge 75 f. wide with the same depth, at an estimated cost of $47,000. **81**, 532, 533; **85**, 519; **86**, 580.

Lt. Col. Gillespie states, in 1888, that the improved channel meets all existing requirements, and further appropriations are therefore not recommended, **88**, 456.

By Lt. Col. Mansfield, 1891, Mystic River, Boston & Maine R. R. bridge to the head of navigation, widening and deepening the natural channel of the river to 100 f. width and 6 f. depth at m. l. w. to the first turn above Dennings wharf, and thence to the head of navigation 4 f. deep, with the width gradually reduced to 50 f. at Cradock Bridge; estimate, $30,000, **91**, 674, 675, 740.

In 1890, Mystic River and Malden River works were combined, the project being the completion of the project of 1882; estimate, $37,000, **1900**, 1191.

By Lt. Col. Mansfield, 1892, using $5,000 of 1892 appropriation to improve Malden River whenever additional funds would be available, and for expending $5,000 for Mystic River as proposed, **93**, 762.

In 1894 Lt. Col. Mansfield proposed to use available funds to complete the project for improvement of Mystic River to a point 1,500 f. above Dennings wharf, and to widen the improved channel of Malden River to a width of 70 f. to the first bridge, **95**, 619.

By Lt. Col. Mansfield, 1896, expenditure of available funds in completing the improvement of Mystic River as far as funds would permit, in completing the project for the improvement of Malden River below the first bridge, and in making a cut of full depth and 25 f. width above the bridge, **97**, 841.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction of Col. Thom, **81**, 532.

Examination for straightening and deepening the channel ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Gillespie, **89**, 594.

Survey, Mystic River, ordered by act of Sept. 19, 1890, made, 1891, under direction of Col. Mansfield, **91**, 674.

MAPS. Mystic River, **91**, 674.

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[a] Malden River only.

## MAMARONECK HARBOR, N. Y.

**Appropriations.**

1882, $15,000, **83**, 525.
1896, 10,000, **96**, 729.
1899, 7,000, **99**, 1211.

Total, 32,000

**Contracts.**

**1883.** J. H. Fenner, rock removed, $13,000, **83**, 525.

**1896.** McSpirit & Sons, dredging, 46,154 c. y., at 19.5 cents per c. y., s. m., **97**, 1088.

**1899.** J. McSpirit & Sons, dredging, 27½ cents per c. y. ($6,050); excavation, $8 per c. y., **99**, 1212.

**Engineers.**

Chief of Engineers. Reports, **81**, 97; **82**, 97; **83**, 92; **84**, 98; **85**, 89; **86**, 90; **87**, 52; **88**, 53; **96**, 83; **97**, 117; **98**, 113; **99**, 126; **1900**, 143.

Engineers in Charge:

Maj. J. W. Barlow, 1881–83. Report, **82**, 637.

Lt. Col. W. McFarland, 1883–86. Reports, **83**, 524; **84**, 655; **85**, 662.

Lt. Col. D. C. Houston, 1886–87. Reports, **86**, 657; **87**, 622; (Col.), **88**, 569.

Maj. H. M. Adams, 1896–98. Reports, **96**, 728; **97**, 1087; **98**, 995.

Lt. Col. W. H. Benyaurd, 1899. Report, **99**, 1210.

Maj. E. H. Ruffner, 1900. Report, **1900**, 1381.

Assistant. H. N. Babcock. Report, **82**, 638.

**Operations.**

**1883–84.** Rock removed under Fenner's contract completed, **84**, 655.

**1896–97.** 47,800 c. y. dredged, **97**, 1087.

**1899–1900.** 22,677 c. y. dredged, and ½ c. y. rock removed, **1900**, 1382.

**Physical characteristics.**

Description of, **88**, 569.

**Projects.**

By Maj. Barlow, 1882, Mamaroneck Harbor, removal of Round Rock and part of Nells Rock to 4-f. depth, and of Bush Rock, Inner and Outer Steamboat rocks, and Little Nanhook to 7-f. depth, together with the excavation of a 7-f. channel 100 f. wide to the old steamboat wharf and continuing it with 4-f. depth and 80-f. width to new steamboat wharf; estimate, $43,000, **82**, 639, 640; **87**, 623; **88**, 569.

By Lt. Col. Benyaurd, 1899, to omit the removal of the three outer rocks, and to extend the channel, 7 f. deep and 100 f. wide, from the old steamboat wharf to the upper wharves, without changing the estimated cost for completion, **99**, 1211.

**Surveys.**

Ordered by act of Mar. 3, 1881, made, 1882, under direction of Maj. Barlow, **82**, 637.

Maps. **83**, 524; **86**, 656.

## MANASQUAN (SQUAN) RIVER, N. J.

**Appropriations.**

1879, $12,000, **79**, 68.
1880, 20,000, **80**, 548.
1882, 7,000, **82**, 703.
1890, 2,000, **91**, 1012.
1899, 5,000, **99**, 1315.

Total, 46,000

**Commerce.**

Not unimportant, **79**, 465.

Harbor available as a harbor of refuge, **79**, 465; **80**, 552; **81**, 713; **82**, 702.

Uncertainty of condition of harbor entrance an effectual bar to growth of commerce, **81**, 711.

**Contracts.**

**1879.** C. F. Drake, jetties, annulled for failure to commence, **80**, 547; **81**, 710.

**1880.** H. Du Bois & Sons, timber jetty construction, **81**, 712.

**1882.** S. A. Kelly, timber jetty construction, **83**, 585.

**1899.** R. Parrott, repairing north dike (timber and iron work), aggregate, $653.50, **1900**, 1515.

**Engineers.**

Chief of Engineers. Reports, **78**, 63; **79**, 68, 74; **80**, 88; **81**, 112; **82**, 112; **83**, 109; **84**, 116; **85**, 107; **86**, 102; **87**, 75; **88**, 75; **91**, 106; **92**, 109; **93**, 118; **94**, 107; **95**, 119; **98**, 143; **99**, 162; **1900**, 186.

Board of Engineers. Convened at New York Apr. 6, 1880, to consider the project of Col. Macomb for improvement of the Manasquan River, **80**, 548. (Cols. Macomb, Tower, and Newton and Maj. Abbot.)

Engineers in Charge:

Col. J. N. Macomb, 1878–80. Reports, **78**, 63; **79**, 66, 74, 463; **80**, 553.

Lt. Col. N. Michler, 1880–82. Reports, **80**, 547; **81**, 710, 712.

Lt. Col. G. L. Gillespie, 1882–86. Reports, **82**, 701; **83**, 583; **84**, 751; **85**, 756.

Lt. Col. W. McFarland, 1886. Report, **86**, 751.

Lt. G. McC. Derby, 1887–88. Reports, **87**, 782; (Capt.), **88**, 667.

Capt. T. L. Casey, 1891–94. Reports, **91**, 1010; **92**, 897; **93**, 1133; **94**, 822.

## MANASQUAN (SQUAN) RIVER, N. J.—Continued.

Lt. Col. G. L. Gillespie, 1895. Report, **95**, 997.

Maj. A. M. Miller, 1898. Report, **98**, 1070.

Col. J. W. Barlow, 1899–. Reports, **99**, 1314, **1900**, 1514.

ASSISTANTS:

Capt. W. Ludlow. Report, **79**, 463.

E. Mahlo. Report, **79**, 466.

C. S. Kelsey. Report, **91**, 1011.

**Operations.**

**1881–82.** 1,515 l. f. timber jetty constructed, **82**, 702.

**1882–83.** 475 l. f. of south jetty built, **83**, 584.

**1899–1900.** North dike repaired, **1900**, 1515.

**Physical characteristics.**

Description of, **79**, 463, 464, 466; **88**, 667.

Table of tides, **79**, 466.

Description of changes since 1883. In 1898 the condition of the river was worse than when work of improvement was commenced. **98**, 1071.

**Plans.** (See *Projects.*)

For a canal from Barnegat Bay to Manasquan River, 1839; work never begun; funds insufficient; discussion of plan by Col. Macomb, **79**, 464.

**Projects.** (See *Plans.*)

By Col. Macomb, 1879, jetties at the inlet to control and to concentrate the scouring action of ebb tides; improvement of the upper river by dredging and removal of wrecks, logs, and snags; estimate, $52,120, **72**, 68, 462, 464; **86**, 751.

The Board of Engineers of 1880 reported that the jetties proposed would be insufficient to maintain the desired improvement, **80**, 552; **86**, 752. Conclusions of Board justified by subsequent experience, **86**, 754.

In 1882 Col. Gillespie proposed extension of the north jetty seaward 255 f., and construction of 905 l. f. of jetty on south side; estimate, $40,000, **82**, 702; **86**, 753.

In 1897 Maj. Miller estimated it would cost $20,000 to complete the improvement, **98**, 1071.

**Surveys.**

Ordered and in progress, **78**, 63.

Completed by E. Mahlo, **79**, 68, 74, 463, 466.

Survey authorized by Chief of Engineers, made by Maj. Miller in 1897, **98**, 1070.

MAPS. **79**, 464; **80**, 550; **82**, 702; **87**, 782; **98**, 1070.

## MANATEE RIVER, FLA. (See also *Pease River, Fla.*)

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $12,000.00, | **83**, 1028. |
| 1886, | [a]11,000.00, | **86**, 1151; **87**, 1241. |
| 1888, | 5,000.00, | **88**, 1109. |
| 1890, | 6,000.00, | **90**, 1603. |
| 1892, | 6,000.00, | **92**, 1386. |
| 1894 | 3,000.00, | **95**, 1556. |
| | 56.37 | (claim), act Aug. 23. |
| 1896, | [b]4,000.00, | **96**, 1333. |
| 1899, | 10,000.00, | **99**, 1631. |
| Total, | 57,056.37. | |

**Commerce.**

Description of, **97**, 1562.

Commerce of the river and Terraceia Bay of sufficient importance, 1896, to warrant an improvement of the Cut-off, **97**, 1562.

In 1898 the locality had become the largest shipping point for fruits and vegetables on the west coast of Florida, **98**, 1339.

**Contracts.**

**1883.** J. Maguire, dredging, 49$\frac{2}{10}$ cents per c. y., **83**, 1029.

**1886.** R. Moore, dredging, 50 cents per c. y., **87**, 1241.

**1888.** D. G. Ambler, dredging, 29 cents per c. y., **89**, 1341.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **82**, 186; **83**, 197; **84**, 205; **85**, 197; **86**, 195; **87**, 159; **88**, 147; **89**, 170; **90**, 152; **91**, 191; **92**, 188; **93**, 267; **94**, 192; **95**, 218; **96**, 195; **97**, 248; **98**, 242; **99**, 281; **1900**, 319.

ENGINEERS IN CHARGE:

Maj. A. N. Damrell, 1881–85. Reports, **82**, 1319; **83**, 1028; **84**, 1215.

Capt. W. T. Rossell, 1885–86. Report, **85**, 1272.

Capt. W. M. Black, 1886–92. Reports, **86**, 1150; **87**, 1239; **88**, 1107; **89**, 1340; **90**, 1602; **91**, 1653.

Maj. J. C. Mallery, 1892. Report, **92**, 1384.

Lt. A. M. D'Armit, 1893. Report, **93**, 1668.

Maj. T. H. Handbury, 1894–95. Reports, **94**, 1238; **95**, 1555.

Lt. Col. W. H. H. Benyaurd, 1896–98. Reports, **96**, 1332; **97**, 1562; **98**, 1338.

Capt. H. Jervey, 1899. Report, **99**, 1630.

Capt. T. H. Rees, 1900. Report, **1900**, 2020.

ASSISTANTS.

P. Robinson. Report, **82**, 1320.

J. H. Bacon. Report, **88**, 1109.

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[a] Part of $13,000, $2,000 of which was for Pease River, **87**, 1241. [b] $3,000 for improvement of the Cut-off

## MANATEE RIVER, FLA.—Continued.

**Operations.**

**1882–83.** 2,405 c. y. dredged from channel in Tampa Bay, **83**, 1028.

**1883–84.** 18,864 c. y. dredged from cut between Tampa Bay and Shaw's Point, **84**, 1216.

**1887–88.** 15,302 c. y. dredged from the cut, **88**, 1108.

**1889–90.** 14,977 c. y. dredged, **90**, 1603.

**1892–93.** 1,389 c. y. dredged, **93**, 1669.

**1893–94.** 22,300 c. y. dredged, **94**, 1240.

**1897–98.** 20,074 c. y. dredged, and a temporary training wall 1,475 f. long built. Three channel marks were built. **98**, 1338.

**1899–1900.** 53,231 c. y. dredged, **1900**, 2021.

**Physical characteristics.**

Description of, **88**, 1108.

**Projects.**

By Maj. Damrell, 1882, channel 100 f. wide and 13 f. deep at m. l. w., Tampa Bay to Shaws and McNeills Points, 4 miles; estimate, $70,000, **82**; 1321; **83**, 1028; **86**, 1151.

This project was subsequently modified, increasing the estimate to $73,000, to provide for opening up the entire lower river to light-draft boats, by the formation of a channel 100 f. wide and 8 f. deep at m. l. w. from Tampa Bay to Manatee, **90**, 1602; **91**, 1653.

Lt. D'Armit, 1892, dredging with a Government dredge a cut 100 f. wide and 12 f. deep at m. l. w. through the bulkhead at Snead Point, **93**, 1669.

In 1897 Lt. Col. Benyaurd estimated that it would cost $20,000 to form a channel 100 f. wide and 6 f. deep at m. l. w., connecting the 6-f. contours of Manatee River and Terraceia Bay, **97**, 1562; a project on this basis was approved in 1897, **98**, 1338.

**Surveys.**

Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. Damrell, **82**, 1319.

Made, 1888, under direction of Capt. Black, **88**, 1108, 1109.

Survey was authorized to ascertain the character and extent of the improvement required at the Cut-off for the improvement of which Congress appropriated $3,000 in 1896. The survey was made by Lt. Col. Benyaurd, 1897 (report favorable). (See *Projects.*) **97**, 1562.

MAPS. **88**, 1108; **97**, 1562.

## MANCHAC BAYOU, LA. (See *Amite River, La.*)

## MANCHESTER HARBOR, MASS.

**Appropriations.**

| | | | |
|---|---|---|---|
| 1888, | $2,500, | **89**, | 567. |
| 1890, | 5,000, | **90**, | 494. |
| 1892, | 6,800, | **92**, | 570. |
| 1899, | 5,000, | **99**, | 1069. |

Total, 19,300

**Commerce.**

Coal, lumber, etc., required for local consumption, **96**, 599.

**Contracts.**

**1890.** Hamilton & Sawyer, dredging, 29 cents per c. y.; removal of bowlders, $6 each, **91**, 639.

**1892.** E. P. Lovering, dredging at 27 cents, removal of bowlders over 3 t., $7 ($6,000), **93**, 755.

**1899.** A. B. Martin, dredging, 33½ cents per c. y.; removing bowlders over 3 t., $5 each (13,433 c. y.), **99**, 1069.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **88**, 26, 32; **89**, 36; **90**, 31; **91**, 37; **92**, 44; **93**, 43; **94**, 41; **95**, 44, 53; **96**, 46; **97**, 51, 64, 65; **98**, 58; **99**, 68; **1900**, 75.

ENGINEERS IN CHARGE:

Lt. Col. G. L. Gillespie, 1888–89. Report, **88**, 463, 466.

Lt. Col. S. M. Mansfield, 1889–98. Reports, **89**, 567; **90**, 493; **91**, 638; **92**, 569; **93**, 754; **94**, 542; **95**, 612, 643; **96**, 598; **97**, 837, 866, 869; **98**, 859.

Col. C. R. Suter, 1899. Report, **99**, 1068.

Maj. W. L. Fisk, 1900. Report, **1900**, 1167.

ASSISTANT: S. Haagensen. Report, **88**, 467.

**Operations.**

**1890–91.** 7,316 c. y. dredged, **91**, 638.

**1891–92.** 14,736 c. y. dredged, **92**, 569.

**1893–94.** About 22,000 c. y. dredged, **94**, 542.

**1899–1900.** 12,935 c. y. dredged, **1900**, 1167.

**Physical characteristics.**

Description of, **95**, 644; **97**, 868.

**Projects.**

By Lt. Col. Gillespie, 1887, restoring the channel to its former depth of from 3 to 4 f. mean low water by the excavation of a channel 4,000 f. long, 60 f. wide, and 4 f. deep, Proctors Point to the town

## MANCHESTER HARBOR, MASS.—Continued.

wharves, 100,000 c. y.; estimate $14,300, **88**, 464, 466; **89**, 567; **92**, 569.

In 1892 Lt. Col. Mansfield proposed that available funds be used to complete the projected improvement, **93**, 755.

Col. Mansfield estimated, 1897, that further channel improvement would cost $139,966.09 (not recommended) or $25,000 (recommended), **97**, 738, 869, 870.

**Surveys.**

Ordered by act of Aug. 5, 1886, made, 1887, under direction of Lt. Col. G. L. Gillespie, **88**, 466.

Examination ordered by act of Aug. 17, 1894, made by Lt. Col. Mansfield, 1894 (report favorable to limited improvement), **95**, 643.

Survey ordered by act of June 3, 1896, made by Lt. Col. Mansfield, 1896 (see *Projects*) (report unfavorable), **97**, 866.

Resurvey ordered by act of June 3, 1897, made by Lt. Col. Mansfield, 1897 (report favorable to limited improvement), **97**, 869.

MAPS, **88**, 466; **97**, 870.

## MANISTEE HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1867, | $60,000, | **67**, 26. |
| 1870, | 20,000, | **70**, 40; **71**, 136. |
| 1871, | 9,000, | **71**, 136. |
| 1872, | 10,000, | **72**, 36. |
| 1873, | 10,000, | **73**, 37. |
| 1874, | 10,000, | **74**, 43. |
| 1875, | 25,000, | **75**, 47. |
| 1876, | 14,000, | **76**, 100. |
| 1878, | 15,000, | **78**, 120, 1203. |
| 1879, | 10,000, | **79**, 162, 1605, 1606. |
| 1880, | 10,000, | **80**, 2012. |
| 1881, | 10,000, | **81**, 2206. |
| 1882, | 15,000, | **82**, 2288. |
| 1884, | 10,000, | **84**, 1976. |
| 1886, | 10,000, | **86**, 1760. |
| 1888, | 10,000, | **88**, 1905. |
| 1890, | 50,000, | **90**, 2617. |
| 1892, | 50,000, | **92**, 2325. |
| 1894, | 12,000, | **95**, 2810. |
| 1896, | 15,000, | **96**, 2708. |
| 1899, | 20,000, | **99**, 2941. |
| Total, | 395,000 | |

**Commerce.**

Importance as a harbor of refuge, **67**, 116; **68**, 133; **76**, ii, 471.

Important, **66**, iv, 142; **76**, ii, 471.

**Contracts.**

**1867.** Gelly & Weston, materials; G. Eastman, materials; R. N. Gere, materials; H. Starke, labor, **67**, 59, 115, 117.

**1869.** J. D. Jennings, materials and labor; Hasbrouck & Conro, materials, **69**, 87.

**1871.** C. S. Stevens, materials, **71**, 135, 137; annulled, **71**, 137; **73**, 263. C. Fitzsimmons, materials; Pierce & Whaling, materials, **71**, 135, 137. R. P. Thurber, materials, **71**, 135, 137; annulled, **71**, 137; **73**, 263.

**1872.** Bird & Mickle, materials and labor, **73**, 263.

**1873.** Squier & White, materials and labor, **73**, 263; extended, **73**, 263.

**1875.** Dewar & Butler, materials and labor; R. M. Steele, materials and labor, **75**, 245, 247.

**1877.** Squier & White, dredging and revetment, **77**, 904.

**1878.** Squier & White, dredging, **78**, 1202; N. S. Gere, materials, and labor, **79**, 1603, 1606.

**1879.** H. S. Dale, pier extension, dredging, 18½ cents per c. y., **80**, 2012.

**1881.** D. Dewar, pier construction, **81**, 2206. Carkin, Stickney & Cram, pier construction, **81**, 2206.

**1882.** Green Bay Dredge and Pile Driver Co., dredging, 23 cents per c. y., **83**, 1814. Dewar & Wing, pier extension, **83**, 1814.

**1884.** D. Dewar, crib construction, **85**, 2072.

**1886.** D. Drake, edgings, **86**, 1760. S. Belford, materials, **86**, 1760.

**1889.** C. Berner, breakwater construction, $9,331.02; **89**, 2172.

**1890.** Truman & Cooper, dredging, 14 cents per c. y., **91**, 2680.

**1891.** C. H. Starke, dredging, 14½ cents per c. y.; Gaylord & Wing, white-pine timber and plank, $17 per M f., B. M.; S. Bedford, plank, $14.50 per M f., B. M.; G. W. Crouter, bolts and spikes, 3 cents per pound; F. A. Hagen, stone, $2.24 per cord, **91**, 2681.

**1892.** Wisconsin Dredging & Dock Co., pier construction, $25,597.15, **93**, 2901.

**1893.** L. E. Allen, white-pine timber, $17.90 per 1,000 f. ($3,329.83), **93**, 2901. Parkhurst & Wilkinson, driftbolts, 2¼ cents per pound ($331.50), **93**, 2902.

**1896.** N. J. Gaylord, pier repairs, $6,325.13, **96**, 2709. W. A. Starke, dredging, **97**, 2934.

**1897.** Green Bay Dredging Co., dredging, **98**, 2525.

**1899.** Greens Dredging Co., dredging, **1900**, 3921.

**1900.** W. Brownrigg, extension and repair of piers (removing old work, dredging, piles, timber, ironwork, stone filling, and riprap), $13,818.62. Greens Dredging Co., dredging, **1900**, 3921.

## MANISTEE HARBOR, MICH.—Continued.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, iii, 13, 34; **67**, 25; **68**, 35; **69**, 30; **70**, 40; **71**, 38; **72**, 36; **73**, 37; **74**, 43; **75**, 47; **76**, 100; **77**, 105; **78**, 120; **79**, 162; **80**, 215; **81**, 291; **82**, 286; **83**, 293; **84**, 295; **85**, 316; **86**, 311; **87**, 279; **88**, 253; **89**, 296; **90**, 266; **91**, 338; **92**, 323; **93**, 376; **94**, 342; **95**, 385; **96**, 340; **97**, 431; **98**, 419; **99**, 500; **1900**, 563.

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1866–68. Reports, **66**, iv. 142; **67**, 115; **68**, 133.

Capt. F. U. Farquhar, 1869–72. Reports, **69**, 87; **70**, 129; **71**, 135; **72**, 177.

Capt. S. M. Mansfield, 1872–80. Reports, **72**, 185; **73**, 262; **74**, 176; **75**, 245; **76**, ii, 468; **77**, 904; **78**, 1202; **79**, 1603; (Maj.), **80**, 214.

Maj. F. Harwood, 1880–82. Reports, **80**, 2011; **81**, 2205.

Maj. D. P. Heap, 1882–83. Report, **82**, 2287.

Capt. D. W. Lockwood, 1883–87. Reports, **83**, 1813; **84**, 1976; **85**, 2071; **86**, 1759; **87**, 2182.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1904.

Maj. Wm. Ludlow, 1889–93. Reports, **89**, 2171; **90**, 2616, 2618; **91**, 2678; **92**, 2322; **93**, 2897.

Lt. Col. G. J. Lydecker, 1894–96, 1898. Reports, **94**, 2223; **95**, 2808; **96**, 2706; **98**, 2525.

Capt. C. McD. Townsend, 1897. Report, **97**, 2933.

Capt. C. Harding, 1899–. Reports, **99**, 2939; **1900**, 3919.

ASSISTANT. Capt. A. Mackenzie. Reports, **67**, 115; **68**, 133.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Wheeler, $180,949, **66**, iii, 13, 34, iv, 143, 155; **67**, 115; **68**, 133; **74**, 176; **76**, ii, 469.

By Capt. Farquhar, pier extension and revetment, $79,000, **69**, 30, 88; **70**, 40; **74**, 176; **76**, ii, 469. Pile revetment, $13,812.50, **71**, 136.

By Capt. Mansfield, dredging and revetment, $15,948, **72**, 186. Pier extension, $112,000, **73**, 37, 263; **74**, 43, 177, **76**, ii, 469; **77**, 904. Dredging and pile revetment, $13,771, **75**, 47; **76**, ii, 469; **77**, 904. Increasing height of south pier, $1,200, **76**, ii, 469.

**Expenditures.**

In repairs, 1867–76, total, $3,150.66, **76**, ii, 470.

**Obstructions.**

The river, 1894, crossed by 3 bridges between lakes Michigan and Manistee; the last-built bridge was constructed by the city of Manistee under permission of the Secretary of War, on condition that the city should move back certain docks to the dock-head line, and that a 14½-f. channel should be dredged through the south draw. The conditions were not complied with at the expiration of the time limit, **94**, 2226.

**Operations.**[a]

**1867–68.** 320 l. f. north pier crib built; 128 l. f. south pier crib built; 18,326 c. y. dredged; 320 l. f. of superstructure north pier, **68**, 35, 134; **74**, 176, **76**, ii, 472.

**1868–69.** 96 l. f. north pier crib built; 256 l. f. south pier crib built, **69**, 30, 87; **74**, 176; **76**, ii, 472.

**1869–70.** 64 l. f. north pier crib built; 96 l. f. south pier crib built, **70**, 40, 129, 130; **76**, ii, 472.

**1870–71.** Repairs to old north slab pier; superstructure built by hired labor, **71**, 38, 135; **74**, 176; **76**, ii, 472.

**1871–72.** 158 l. f. north pier crib built; 158 l. f. south pier crib built; 115 l. f. south pier superstructure built, **72**, 36, 177, 185; **74**, 177; **76**, ii, 473.

**1872–73.** 600 l. f. north pier pile revetment built; dredging, **73**, 37, 262, 263; **74**, 177; **76**, ii, 473.

**1873–74.** 355 l. f. south pier pile revetment built, **74**, 43, 177; **76**, ii, 473.

**1874–75.** 318 l. f. north pier pile revetment built; 140 l. f. south pier pile revetment built; repairs by hired labor, **75**, 47, 245, 246; **76**, ii, 473.

**1875–76.** 150 l. f. north pier crib built; 150 l. f. south pier crib built; 150 l. f. superstructure north pier; cribs on south pier decked, **76**, 100; ii, 468.

**1876–77.** 450 l. f. south pier superstructure built; south pier increased in height, **77**, 105, 904; **79**, 1605.

**1877–78.** 420 l. f. south pier pile revetment built; 48,610 c. y. dredged; cribs reballasted; slabs removed, **78**, 120, 1202.

**1878–79.** 100 l. f. north pier crib built; 100 l. f. south pier crib built; scow load of brick sunk in channel; stone washed out of cribs, **79**, 162, 1603.

**1879–80.** 3 cribs framed and dredging in progress, **80**, 2011.

**1880–81.** 3 cribs sunk and 11,260 c. y. dredged, **81**, 2205.

**1881–82.** 2 cribs constructed; 3 cribs in north pier extension leveled; superstructure placed thereon; sand fence built along outer face of south pier at beach line; superstructure to north pier extension completed; 10,019 c. y. dredged, **82**, 2288.

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[a] Timber belonging to the United States burned in 1870, **72**, 177; **74**, 176; **76**, ii, 463. 100 l. f. of slab pier washed away, **67**, 115.

115 l. f. of superstructure burned, **73**, 263. Abstracts of work done and material used, **72**, 177. History of operations, **74**, 176; **76**, ii, 470.

**MANISTEE HARBOR, MICH.**—Continued.

**1882–83.** Dredging and pier extension continued, **83**, 1813.

**1883–84.** South pier extended 50 l. f. and 14,002 c. y. dredged, **84**, 1976.

**1884–85.** Repairs to piers damaged by collision, **85**, 2071.

**1885–86.** South pier extended 50 f., **86**, 1760. Condition of improvement, **86**, 1759.

**1886–87.** Portions of north and south pier crib work renewed, **87**, 2183.

**1887–88.** South pier extended 50 f., **88**, 1905.

**1888–89.** Construction of 2 cribs begun under contract, **89**, 2171.

**1889–90.** South pier extended 100 f.; repairs to north pier, **90**, 2616.

**1890–91.** 57,800 c. y. dredged; crib construction in progress, **91**, 2678.

**1891–92.** 40,784 c. y. dredged; 200 l. f. of north pier extension completed; 764 l. f. of north revetment rebuilt; repairs to north pier, **92**, 2323.

**1892–93.** Extension of north pier in progress, **93**, 2898, and repairs made to piers and revetments, **93**, 2899; and 24,970 c. y. dredged and gauge readings made, **93**, 2900.

**1893–94.** North pier extension completed, **94**, 2224; general repairs made to old structures and 45,798 c. y. dredged, **94**, 2225.

**1895–96.** General repairs made, **96**, 2707.

**1896–97.** Parts of north and south piers rebuilt, **97**, 2904.

**1897–98.** 11,664 c. y. dredged, **98**, 2525.

**1898–99.** 11,891 c. y. dredged, **99**, 2939.

**1899–1900.** 27,639 c. y. dredged; extension and repair of south pier and repair of north pier in progress, **1900**, 3919.

**Physical characteristics.**

Soundings, **66**, iv, 142; **67**, 115; **76**, ii, 470, 471, 472, 473; **79**, 1605.

General, Manistee Harbor and River, **66**, iv, 142; **67**, 116; **68**, 133; **76**, ii, 470.

**Plans.** (See *Estimates* and *Projects.*)

By Maj. Ludlow, 1889, extension of the north pier 550 f. to the 18-f. curve in the lake, and the south pier 350 f. to the 14-f. curve; also for dredging a 15-f. channel between the piers; estimate, $115,000, **90**, 2619.

**Private (city and corporate) work.** (See *Obstructions.*)

Diverging slab piers built, **66**, iii, 13, iv, 143; **76**, ii, 471.

Dredging in channel between lakes Michigan and Manistee; dredge owned by town, **73**, 263; **74**, 177; **76**, ii, 472.

In 1893 the Manistee & Northeastern R. R. Co. given permission by the Secretary of War to rebuild a part of the north revetment and to build a dock on the north bank of the Manistee River, **93**, 2900, on agreement to keep the revetment in repair, **94**, 2226. No disposition on the part of railroad company to make repairs as agreed, **99**, 2940.

Private company granted permission to use part of south pier on condition that part occupied would be repaired when needing repair, **1900**, 3919.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Wheeler, parallel extension of piers by crib work to 12 f. of water, 1,000 l. f. each, **66**, iii, 13, iv, 142, 143; **76**, ii, 471. Extension of both piers 960 f.; to cut off point of old slab pier; also to cut down slab work to water's surface and build crib superstructure thereon; dredging to 12 f., **67**, 25, 115; **68**, 35, 133; **76**, ii, 469, 471. Modification of the above (which was based on the survey of 1866) caused by the destruction of 100 l. f. of north pier, **67**, 25, 26, 115.

Pier extension and revetment, 1869, **69**, 30, 88; **74**, 176; **76**, ii, 469.

For 850 f. of pile revetment on the north side of channel, **71**, 136.

By Capt. Mansfield, dredging and revetment within entrance, **72**, 36, 186. Pier extension to 16 f. of water, north pier 650 l. f. and south pier 750 l. f., **73**, 37, 263; **74**, 43, 177; **75**, 246; **76**, ii, 469. To increase the height of 450 l. f. of the south pier, **76**, ii, 469. The original project stated to be a pier extension of 480 l. f. on each side of the channel and dredging 27,898 c. y., **76**, ii, 469.

The project of 1866, with the modifications of 1870 and 1874, proposed the parallel extension of crib piers to obtain at least 12 f. depth of channel; estimate, $180,949, **76**, 469. Modified in 1870 and 1874 for extension of piers, at a total estimate of $234,000, **80**, 2012. In 1886, after appropriations of $248,000, it was estimated that $92,700 would be required to complete project, **86**, 1760.

In 1890, after a further appropriation of $60,000, Maj. Ludlow estimated $75,000 as requisite for completion of project, **90**, 2617; **91**, 2679.

**Surveys.**

By Capt. G. G. Meade, 1861, **76**, ii, 470.

By W. T. Casgrain, 1866, **66**, iv, 142; **67**, 115; **76**, ii, 470.

Under direction of Maj. Wheeler, 1868, **76**, ii, 472.

Under direction of Capt. Farquhar, 1869-70, **76**, ii, 472, 473.

Survey made, 1893, by Lt. Col. Lydecker, **94**, 2225.

MAPS. **82**, 2288; **84**, 1976, **90**, 2618.

## MANISTIQUE HARBOR, MICH.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $5,000, | **80**, 1902. |
| 1881, | 1,000, | **81**, 2054. |
| Total, | 6,000 | |

**Commerce.**
Local, **73**, 254.

**Contracts.**
**1881.** Chicago Lumbering Co., dredging, 15 cents per c. y., **81**, 2055.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **73**, 36; **79**, 155; **80**, 203, 206; **81**, 273; **82**, 268; **83**, 276; **84**, 276; **85**, 299; **86**, 293; **87**, 259; **88**, 235; **89**, 274; **90**, 247; **91**, 317; **92**, 303; **93**, 344; **94**, 315; **95**, 353; **96**, 308.

ENGINEERS IN CHARGE:

Maj. D. C. Houston. Report, **73**, 254.

Maj. H. M. Robert, 1879–83. Reports, **80**, 1902, 1931; **81**, 2054, 2055, 2057; **82**, 2117, 2118.

Maj. J. W. Barlow, 1883, 1884–86; **83**, 1629. Reports, (Lt. Col.) **84**, 1832; **85**, 1974.

Capt. F. A. Hinman, 1883–84 Report, **83**, 1637.

Capt. W. L. Marshall, 1886; **86**, 290.

Capt. C. E. L. B. Davis, 1886–92. Reports, **86**, 1649; **87**, 2001; (Maj.), **88**, 1835; **89**, 2042; **90**, 2326; **91**, 2523.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2170; **93**, 2700; **94**, 2042.

Capt. C. F. Palfrey, 1895. Report, **95**, 2592.

Capt. G. A. Zinn, 1896. Report, **96**, 2458.

ASSISTANTS:

J. Pierpont. Report, **73**, 255.

L. Y. Schermerhorn. Report, **80**, 1931.

**Operations.**
**1880–81.** 11,780 c. y. dredged, **81**, 2054.

**1881–87.** Operations abandoned for refusal of interests controlling the harbor to rectify pier lines, **82**, 2118; **86**, 293; **87**, 2001.

**Physical characteristics.**
General, **73**, 255.

**Plans.** (See *Projects.*)
By Maj. Houston, 1873, two crib piers extending to the 18-f. curve, and dredging in channel; estimate, $290,000. Probability that an east pier would not be necessary, and that the scouring action of the river current would reduce the amount of dredging. **73**, 255.

**Projects.** (See *Plans* and *Operations.*)
By Maj. Robert, 1879, removal of 20,000 c. y. of sand from between piers; estimate, $6,000, **80**, 1932.

**Surveys.**
Under direction of Maj. Houston, 1872, by J. Pierpont, **73**, 36, 255.

Ordered by act of Mar. 3, 1879, made, 1880, under direction of Maj. Robert, **80**, 1931.

Survey made, 1890, under direction of Maj. Davis, **90**, 2326.

MAPS. **81**, 2054.

## MANITOWOC HARBOR, WIS.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1852, | $8,000, | **66**, iii, 35. |
| 1866, | 52,000, | **66**, iii, 35. |
| 1867, | 45,000, | **69**, 26. |
| 1868, | 17,500, | **69**, 26 (allotted). |
| 1869, | 17,820, | **69**, 22 (allotted). |
| 1870, | 20,000, | **70**, 35. |
| 1871, | 11,000, | **71**, 33. |
| 1873, | 20,000, | **73**, 33. |
| 1874, | 10,000, | **74**, 39. |
| 1875, | 10,000, | **75**, 43. |
| 1876, | 8,000, | **76**, 96. |
| 1878, | 15,000, | **78**, 115. |
| 1879, | 6,500, | **79**, 154. |
| 1880, | 7,000, | **80**, 1918. |
| 1881, | 4,000, | **81**, 2094. |
| 1882, | 10,000, | **82**, 2147. |
| 1884, | 15,000, | **84**, 1854. |
| 1886, | 15,000, | **86**, 1669. |
| 1888, | 8,000, | **88**, 1852. |
| 1890, | 8,000, | **90**, 2345. |
| 1892, | 28,000, | **92**, 2192. |
| 1894, | 20,000, | **95**, 2627. |

**Appropriations**—Continued.

| | | |
|---|---|---|
| 1896, | 44,440, | **96**, 2493. |
| 1899, | 3,300, | **99**, 2760. |
| Total, | $403,560 | |

**Commerce.**
Important, **66**, iv, 130; **67**, 73, 74; **68**, 100; **71**, 112; **72**, 120; **73**, 205; **74**, 146; **75**, 205; **76**, ii, 369, 372; **78**, 1160; **79**, 1516; **88**, 1852.

Importance of harbor as harbor of refuge, **67**, 73; **68**, 100; **77**, 863.

Benefit derived from improvement, **80**, 1919.

Importance of the harbor increased in 1895–96 by two railroads establishing car-ferry service across the lake, with this harbor as a terminus, **96**, 2492.

Description of; general commerce of the lakes benefited by the facilities offered by the harbor during storms, **1900**, 3763.

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[a] Surveys—Report: Oct., 1837, estimate $82,979.44; Sept. 30, 1857, estimate $62,780.94. (H. Doc. No. 482, 55th Cong. 2d sess.)

**MANITOWOC HARBOR, WIS.**—Continued.

**Contracts.**[a]
**1866.** D. Smoke, pier extension; Hoes & Packard, pier extension; J. Vilas, pier extension, **66**, iv, 130. J. Schuette, dredging, **76**, ii, 368.
**1868.** D. Smoke, pier extension; J. Schuette, dredging, **76**, ii, 369.
**1869.** D. Smoke, pier extension, **76**, ii, 369. J. Schuette, dredging, **76**, ii, 370.
**1870.** D. Smoke, pier extension, **71**, 111; **76**, ii, 370.
**1871.** R. A. Conolly, pier extension, **71**, 112; **72**, 119.
**1872.** T. Winidate, guard piles, **73**, 203.
**1873.** H. Truman, pier extension, **73**, 204.
**1874.** C. C. Barnes, pier extension, **75**, 204.
**1875-76.** H. Truman, pier extension, **75**, 205; **77**, 363.
**1878.** Truman & Schroeder, pier extension, **79**, 1516, 1517.
**1881.** Truman & Cooper, crib construction, **81**, 2095.
**1882.** Green Bay Dredge & Pile Driver Co., dredging, 22 cents per c. y., **83**, 1689.
**1886.** Truman & Cooper, crib construction, **87**, 2045.
**1888.** Truman & Cooper, superstructure reconstruction 400 f., $3,120.80, **89**, 2061.
**1890.** Truman & Cooper, 600 l. f. of pier superstructure construction, $4,884, **91**, 2547.
**1894.** Wisconsin Dredge & Dock Co., breakwater, 400 l. f., piles, stone, etc., $24,678.13, **95**, 2628. Actual cost, $64.11 per l. f., **96**, 2492.
**1896.** Hausler & Lutz Towing & Dock Co., 500 l. f. crib pier extension, piles, stone, etc., $27,633.50, **97**, 2683. Actual cost, $54.75 per l. f., **98**, 2317.

**Documents.** (Not published in reports.)
S. Doc. No. 16, 34th Cong., 3d sess.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **66**, iii, 12; **67**, 21; **68**, 29; **69**, 25; **70**, 35; **71**, 33; **72**, 32; **73**, 33; **74**, 39; **75**, 43; **76**, 96; **77**, 100; **78**, 115; **79**, 154; **80**, 205; **81**, 277; **82**, 273; **83**, 282; **84**, 282; **85**, 305; **86**, 299; **87**, 264; **88**, 240; **89**, 279; **90**, 252; **91**, 323; **92**, 309; **93**, 352; **94**, 323; **95**, 361; **96**, 316; **97**, 400; **98**, 392; **99**, 464, 474; **1900**, 529, 538, 539.
ENGINEERS IN CHARGE:
Maj. J. D. Graham, T. E., 1854-57. Reports, S. Doc. 42, 35th Cong., 1st sess., pp. 2, 73, 175; S. Doc. 16, 34th Cong., 3d sess.
Maj. J. B. Wheeler, 1866-70. Reports, **66**, iv, 129; **67**, 73; **68**, 99.
Maj. D. C. Houston, 1870-75. Reports, **70**, 93; **71**, 111; **72**, 119; **73**, 203; **74**, 145.
Maj. H. M. Robert, 1875-83. Reports, **75**, 203; **76**, ii, 366; **77**, 863; **78**, 1160; **79**, 1516; **80**, 1917; **81**, 2094; **82**, 2146.
Maj. J. W. Barlow, 1883. Report, **83**, 1629.
Capt. F. A. Hinman, 1883-84. Report, **83**, 1688.
Lt. Col. J. W. Barlow, 1884-86. Reports, **84**, 1853; **85**, 1998.
Capt. W. L. Marshall, 1886. **86**, 290.
Capt. C. E. L. B. Davis, 1886-92. Reports, **86**, 1667; **87**, 2044; (Maj.), **88**, 1851; **89**, 2060; **90**, 2343; **91**, 2545.
Maj. J. F. Gregory, 1892-94. Reports, **92**, 2191; **93**, 2730; **94**, 2072.
Capt. C. F. Palfrey, 1895. Report, **95**, 2626.
Capt. G. A. Zinn, 1896-98. Reports, **96**, 2491; **97**, 2681; **98**, 2316.
Capt. J. G. Warren, 1899-. Reports, **99**, 2759; **1900**, 3683, 3761, 3764.
ASSISTANTS:
Lt. J. B. Quinn. Report, **67**, 73.
W. H. Hearding. Reports, **68**, 99; **72**, 119; **73**, 203; **74**, 145; **75**, 203.
L. Y. Schermerhorn. Report, **81**, 2096.

**Expenditures.**
For repairs of piers, **76**, ii, 367; **77**, 864; **78**, 1161.

**Operations.**[b]
**1854-55.** 64 l. f. north pier crib built; 160 l. f. south pier crib built, S. Doc. 42, 35th Cong., 1st sess., p. 73, **76**, ii, 368.
**1866-67.** 512 l. f. north pier crib built; 576 l. f. north pier superstructure built, **67**, 21, 73; **76**, ii, 368.
**1867-68.** 288 l. f. north pier crib built; 288 l. f. north pier superstructure built; 416 l. f. south pier crib built; 62,092 c. y. dredged (dredging in channel and for cribs), **68**, 100; **76**, ii, 369.
**1868-69.** 64 l. f. north pier crib built; 320 l. f. south pier crib built; 416 l. f. south pier superstructure built; 53,714 c. y. dredged (dredging in channel and for cribs), **69**, 25; **76**, ii, 369, 370.
**1869-70.** 128 l. f. north pier crib built; 64 l. f. north pier superstructure built; 160 l. f. south pier crib built; 320 l. f. south pier superstructure built, **70**, 93; **76**, ii, 370.
**1870-71.** 128 l. f. north pier crib built; 128 l. f. north pier superstructure built; 96 l. f. south pier crib built; 160 l. f. south pier superstructure built (64 f. close piling), **71**, 33, 111; **76**, ii, 370.

[a] 1876-77. Informal proposals were invited from bidders of previous years, and an agreement concluded with H. Truman for superstructure, 77, 863.

[b] Record of early operations, 1843, 76, ii, 368. Of appropriations of 1876, $5,000 was especially allotted for protecting the work, 76, 36. History of, to 1875, 76, ii, 366.

## MANITOWOC HARBOR, WIS.—Continued.

**1871-72.** 96 l. f. north pier crib built; 128 l. f. north pier superstructure built; 96 l. f. south pier crib built 96 l. f. south pier superstructure built; **72**, 32; **76**, ii, 371.

**1872-73.** 96 l. f. north pier superstructure built; 96 l. f. south pier superstructure built (harbor pier extended to 13 f. of water; guard piles driven; cribs refilled), **73**, 33, 203; **76**, ii, 371.

**1873-74.** 100 l. f. north pier crib built; 100 l. f. south pier crib built (4 cribs sunk on stone foundations of 25 cords each), **74**, 39, 145; **76**, ii, 372.

**1874-75.** 100 l. f. north pier crib built; 100 l. f. north pier superstructure built; 100 l. f. south pier crib built; 100 l. f. south pier superstructure built (1 course of superstructure added; cribs decked with plank; cribs sunk on stone foundations to the channel faces of both piers), **75**, 43, 203, 204; **76**, ii, 372.

**1875-76.** 50 l. f. north pier crib built; 100 l. f. north pier superstructure built; 50 l. f. south pier crib built; 100 l. f. south pier superstructure built (repairs to piers by hired labor), **76**, 96, ii, 366, 367.

**1876-77.** 50 l. f. north pier superstructure built; 50 l. f. south pier superstructure built (repairs to piers by hired labor), **77**, 100, 863.

**1877-78.** Repairs to piers by hired labor; 500 l. f. pier decked with plank, **78**, 1161.

**1878-79.** 150 l. f. north pier crib built; 150 l. f. south pier crib built (north pier 1,620 f. long; south, 1,550 f.), **79**, 154, 1516.

**1879-80.** Superstructure over 6 cribs built and half filled with stone; repairs to piers, **80**, 1917.

**1880-81.** Four cribs built and placed in extension of piers; repairs to piers, **81**, 2094.

**1881-82.** Superstructure built over 4 cribs; filling completed; 8,949 c. y. dredged by city of Manitowoc, **82**, 2146.

**1882-83.** 38,492 c. y. dredged from between piers, **83**, 1688.

**1884-85.** Five cribs sunk in extension of north pier and superstructure built thereon, **85**, 1998.

**1885-86.** Repairs to north pier, **86**, 1668.

**1886-87.** Four cribs sunk in extension of south pier, **87**, 2045.

**1887-88.** One crib sunk, extending the south pier 50 f., and 12,250 l. f. of superstructure completed upon south pier, **88**, 1851.

**1888-89.** 4,490 c. y. dredged by city of Manitowoc and private parties; 30,350 c. y. dredged by hired labor; 400 l. f. of south pier completed under contract, **89**, 2060.

**1890-91.** 9,464 c. y. dredged; 400 l. f. of north pier rebuilt, **91**, 2546.

**1891-92.** 342 l. f. of north pier rebuilt; 2,429 c. y. dredged, **92**, 2192.

**1892-93.** 4,173 c. y. dredged and dredging plant repaired, **93**, 2731.

**1893-94.** 592 l. f. south pier repaired and minor repairs made, **94**, 2072.

**1894-96.** Breakwater construction in progress; 43,453 c. y. dredged and dredging plant repaired, **95**, 2627; breakwater 400 f. long was built; 91 l. f. of south and 221 l. f. of north pier rebuilt, **96**, 2492.

**1896-98.** Pier extension in progress; 37,493 c. y. dredged and dredging plant repaired, **97**, 2681; 500 l. f. of south pier extended, north and south piers repaired, and dredging plant also repaired; 58,669 c. y. dredged, **98**, 2317.

**1898-99.** Dredging plant repaired, **99**, 2759.

**1899-1900.** Harbor piers repaired, **1900**, 2684.

**Physical characteristics.**

Advance of shore line in the vicinity of piers, **76**, ii, 372.

Scour of Manitowoc River would keep open a channel protected from encroachments of sand, **66**, iv, 130.

Lake bed unfavorable to the accurate setting of cribs, **73**, 203.

Peculiarities of harbors along the west shore of Lake Michigan, **68**, 99.

Description of. Manitowoc, on the west shore of Lake Michigan, 77 miles north of Milwaukee. Shelter of the harbor sought by many craft. **1900**, 3762.

**Plans.** (See *Projects.*)

By W. H. Hearding, 1873, system of outside breakwaters covering entrance to harbor; objections to plan by Maj. Houston, **73**, 204, 205.

By Maj. Davis, 1890, exterior harbor protection of crib work 400 f. long, built at an angle of 45 degrees with the line of direction of the piers and about 600 f. beyond the lake end of the north pier; estimate, $40,000, **90**, 2345.

**Private (city, private, and corporate) work.**

The city expended $20,000 in the construction of dredging outfit, **76**, ii, 368.

Docking within piers, 1870; dredging to 11 f. for a mile inside eastern ends of piers, **71**, 112; **76**, ii, 371.

Dredging to 13 f., **72**, 120; $15,000 additional expended by citizens in dredging, **76**, ii, 372.

Dredging done by city and private parties, **89**, 2060.

In 1896 the Secretary of War granted permission to the Chicago & Northwestern Rwy. Co. to remove 320 l. f. of the shore end of the south pier to enable them to construct a car ferry slip, and to construct 2,000 l. f. of protection cribs along the shore of Lake Michigan to afford protection to the ferry, **97**, 2682.

## MANITOWOC HARBOR, WIS.—Continued.

In 1896–97 the city dredged about 273,400 c. y., at a cost of $25,940.46, from the river, making a depth of about 20 f. from the harbor piers up the river for about 5,500 f. The Manitowoc Terminal Co. also dredged 60,000 c. y. from along its docks, **97**, 2682.

In 1897–98 more dredging by the city was in progress, **98**, 2317.

**Projects.** (See *Plans.*)

By Maj. Graham, 1854, extension of parallel piers (220 f. apart) to the 12-f. curve; estimate, $62,780.94; S. Doc. 42, 35th Cong., 1st sess.

By Maj. Wheeler, 1866, revising previous project and providing for an extension to the 12-f. curve, by extending the north pier an additional 1,140 f. and the south pier 1,010 f., with dredging to a depth of 12 f.; estimate, $141,747.82, **66**, iv, 129, 131; **69**, 26.

The foregoing estimate increased by Maj. Wheeler, 1869, by $31,000, to supply deficiency due to repairs, and increased amount of dredging, **69**, 26; **70**, 93.

Revised by Maj. Houston, 1872, extension of the piers to the 18-f. curve, requiring 400 f. on each pier; estimate, $75,434.72, **72**, 121; **74**, 146; **79**, 1516.

By Maj. Robert, 1879, completion of existing project, $15,362.54, **79**, 1516.

The original project of 1866, together with the modifications of 1869, 1872, and 1881, proposed the formation of a channel between two parallel crib piers 250 f. apart between the 18½-f. curve in the lake and deep water in the river, 14 f. deep at the inner end, increasing to 18 f. at the outer end; estimate, $308,182.54; **81**, 2094; **86**, 1667; **87**, 2044.

In 1890 the construction of an exterior breakwater 400 f. in length was proposed, at an estimate of $40,000, which, with $12,000 for preservation of piers and maintenance of channel, increased the total to $348,182, **92**, 2192.

By Capt. Zinn, 1896, for a 20-f. channel, by extending the south pier 500 f. to the 20-f. contour, and dredging between piers; estimate, $44,440, **96**, 2491; **97**, 2681.

Capt. Warren estimated, 1899, it would cost $37,000 to extend the breakwater 400 f. on a line parallel with south pier, **1900**, 3765.

**Surveys.**

Of harbor, 1853, **76**, ii, 368.

Under direction of Maj. Graham, 1856, S. Ex. Doc. 42, 35th Cong., 1st sess., p. 73.

Survey made, 1890, under direction of Maj. Davis, **90**, 2344.

Minor surveys. (See each annual report.)

Examination and survey for protection of the harbor from northeast seas by breakwater extension ordered by act of Mar. 3, 1899, made, by Capt. Warren, 1899 (report favorable), **1900**, 3761.

Act of June 6, 1900, called for preliminary examination and survey for 20-f. harbor of refuge (unnecessary), **1900**, 3684.

MAPS. **66**, i; **76**, ii, 366; **88**, 1852; **93**, 2732.

## MANKATO, MINN. (See *Minnesota River.*)

## MANOKIN RIVER, MD.

**Appropriations.**

| | | |
|---|---|---|
| 1890, | $7,500, | **91**, 1197. |
| 1892, | 7,500, | **92**, 977. |
| 1894, | 4,000, | **95**, 1143. |
| 1896, | [a]4,000, | **96**, 970. |
| 1899, | 1,500, | **99**, 1395. |

Total, 24,500,

**Contracts.**

**1891.** F. C. Somers, dredging, 15¼ cents per c. y., **91**, 1197.

**1892.** F. C. Somers, dredging, 9 cents per c. y., p. m., **93**, 1224.

**1895.** Baltimore Dredging Co., dredging, 19.8 cents per c. y., p. m., **95**, 1144.

**1896.** C. T. Caler, dredging, 9½ cents per c. y., p. m., **97**, 1283.

**1899.** Baltimore Dredging Co., dredging, 12.4 cents per c. y., p. m., **1900**, 1658.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 151; **89**, 112; **90**, 102; **91**, 129; **92**, 129; **93**, 141; **94**, 130; **95**, 148; **96**, 135; **97**, 168; **98**, 172; **99**, 200; **1900**, 227.

ENGINEERS IN CHARGE:

Capt. T. Turtle. Report, **84**, 951.

Maj. W. F. Smith, U. S. agent, 1888–. Reports, **90**, 959; **91**, 1195; **92**, 976; **93**, 1223; **94**, 901; **95**, 1143; **96**, 969; **97**, 1282; **98**, 1168; **99**, 1394; **1900**. 1657.

ASSISTANT. A. Stierle. Report, **90**, 960.

**Operations.**

**1890–91.** 42,016 c. y. dredged, **91**, 1196.

**1892–93.** 62,013 c. y., p. m., dredged, **93**, 1223.

**1895–96.** 15,062 c. y., p. m., dredged, **96**, 970.

**1899–1900.** 34,033 c. y. dredged, **1900**, 1657.

**Physical characteristics.**

Description of, **84**, 951; **90**, 960.

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[a] See *Projects.*

## MANOKIN RIVER, MD.—Continued.

**Projects.**

By Maj. Smith, 1890, channel, Locust to Sharps points, 100 f. wide and 6 f. deep at m. l. w.; estimate, $30,000, **90**, 961; **92**, 976.

The appropriation of 1896 was made with the proviso that $2,000 of it should be used to improve the river, Dashiells Creek to Red Bridge, **96**, 970.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Turtle (report unfavorable), **84**, 951.

Ordered by act of Aug. 11, 1888, made, 1890, under direction of Maj. Smith, **90**, 961.

## MANTUA CREEK, N. J.

**Appropriations.**

1882, $3,000, **83**, 641.
1899, 25,000, **99**, 1366.

Total, 28,000

**Commerce.**

Valued at $2,002,875, 1894, **95**, 1090; **98**, 1125.

**Contracts.**

**1889**. American Dredging Co., dredging, 13 cents per c. y., **90**, 904.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 129; **82**, 126; **83**, 126; **84**, 134; **85**, 123; **86**, 121; **87**, 83; **88**, 83; **89**, 101; **90**, 91; **95**, 132; **98**, 158; **99**, 178; **1900**, 201.

ENGINEERS IN CHARGE:

Capt. W. Ludlow, 1881–83. Report, **82**, 806.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 640.

Maj. W. H. Heuer, 1884–85. Report, **84**, 837.

Lt. Col. H. M. Robert, 1885–90. Reports, **85**, 850; **86**, 844; **87**, 809; **88**, 711; **89**, 873.

Maj. C. W. Raymond, 1890–. Report, **90**, 904; **95**, 1088; (Lt. Col.), **98**, 1122; **99**, 1364; **1900**, 1582.

ASSISTANTS:

E. A. Gieseler. Report, **82**, 807.

A. Stierle. Report, **84**, 837.

**Legal proceedings.**

Condemnation proceedings for right of way, **1900**, 1582.

**Obstructions.**

Stream crossed, 1897, by four bridges, two of them being without draws, **98**, 1122.

**Operations.**

**1889–90**. 20,000 c. y. dredged, **90**, 904.

**Physical characteristics.**

Description of, **88**, 711; **95**, 1089; **98**, 1123.

Empties into Delaware River about 3 miles below Philadelphia. Eleven miles above its mouth it has a width of 100 f. and low-water depth of 2 f., 1895; obstructed by bar at mouth, shoals, and numerous sharp bends, **95**, 1089; **98**, 1123.

**Projects**

By Capt. Ludlow, 1882, Mantua to the mouth, a channel having a low-water depth of 10 f. and a width of 80 f. at the mouth, diminishing to 4 f. depth and 40 f. width at Mantua; estimate, $35,000, **82**, 806.

By Lt. Col. Robert, 1889, channel 60 f. wide and not less than 8 f. deep at m. l. w., 8 f. curve in the Delaware River to Phosphate wharf, 3,000 f.; estimate, $2,900, **89**, 874.

By Maj. Raymond, 1897, dredging a 12 f., 8 f., and 7 f. channel, 100 f., 80 f., and 60 f. wide, respectively, mouth to Parkers Landing; construction of cut-offs, removal of overhanging trees, and, if necessary, jetties at the mouth; estimate, $141,400, **98**, 1122; **99**, 1365.

Act of 1899 appropriated $25,000, $8,000 to be expended for right of way, but not unless all rights should be obtained within that sum, **99**, 1365.

**Surveys.**

Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. Ludlow, **82**, 806.

Examination ordered by act of Aug. 17, 1894, made, 1894, by Maj. Raymond (report favorable), **95**, 1088.

Survey ordered by act of June 3, 1896, made, 1897, by Maj. Raymond (report favorable), (see *Projects*), **98**, 1122.

**MAQUAM BAY, VT.** (See *Swanton Harbor, Vt.*)

**MARAMEC RIVER, MO.** (See *Meramec River.*)

## MARBLEHEAD, MASS.[a]

**Appropriations.**

1825, [b]$400, survey act Mar. 3.
1852, [c]500, act Aug. 30.
1899, 1,000, **99**, 1070.

Total, 1,900.

**Engineers.**

CHIEF OF ENGINEERS. Reports **66**, 7; **97**, 65; **99**, 68; **1900**, 76.

ENGINEERS IN CHARGE:

Col. J. D. Graham, 1865. Report **66**, 36.

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[a] Survey—Report April 24, 1826. (H. Doc. No. 482, 55th Cong., 2d sess.).

[b] Surveys, Marblehead Harbor and Holmes Hole, Mass., to ascertain the practicability and necessity of building a pier at the mouth of the harbor of Marblehead, for the security of shipping, and also a pier in the harbor of Holmes Hole for the same purpose. (Treasury Doc. 378, 1882.)

[c] For sea walls.

## MARBLEHEAD, MASS.—Continued.

Lt. Col. S. M. Mansfield, 1897. Report, **97**, 870.

Col. C. R. Suter, 1899. Report, **99**, 1069.

Maj. W. L. Fisk, 1900. Report, **1900**, 1168.

**Physical characteristics.**

Description of, **97**, 871.

**Surveys.**

Survey with a view to preventing harbor injury by sea breaching isthmus, ordered by act of June 3, 1896, made by Lt. Col. Mansfield, 1897 (report unfavorable), **97**, 870.

Examination made by Maj. Fisk, 1899, **1900**, 1169.

## MARCUS HOOK HARBOR, PA. (See *Delaware River, N. J. and Pa.; Reedy Island Harbor, Del.*)

**Appropriations.**

| | | |
|---|---|---|
| 1829, | $5,000, | **66**, iii, 31. |
| 1866, | 5,000, | **66**, iii, 31. |
| 1867, | 94,000, | **71**, 686. |
| 1880, | 35,000, | **80**, 583. |
| 1881, | 30,000, | **81**, 766. |
| 1882, | 15,000, | **82**, 751. |
| 1886, | 15,000, | **86**, 833. |
| 1888, | 15,000, | **88**, 704. |
| 1890, | 5,000, | **90**, 887. |

Total, 219,000.

**Contracts.**

**1867.** W. H. Rotan, materials and labor. A. P. Eyre, materials and labor. J. C. Leiper, materials. Crane & Keaveny, labor. J. R. Grant, materials. **67**, 435, 436.

Mismanagement and bad faith of A. P. Eyre, **69**, 380. Difficulties and delays caused by the system of letting of, **67**, 431; **71**, 687.

**1880.** Mount Waldo Granite Co., 2 piers, **81**, 767.

**1882.** Leiper & Lewis, pier construction, **83**, 617.

**1884.** Leiper & Lewis, pier construction, **84**, 814.

**1885.** American Dredging Co., dredging, 20 cents per c. y., **86**, 832. Davis, Irvin & Sanville, driving mooring piles, **86**, 833.

**1887.** I. Lunt, ice pier, **87**, 803.

**1888.** F. C. Somers, dredging, 14 cents per c. y. H. H. Dambly, repairs to piers and placing mooring piles, $1,557.50. **89**, 868.

**1892.** Davis & Irvin, repairs to landing piers and placing 7 groups of mooring piles, $1,014, **92**, 930.

Miscellaneous contracts for repairs, etc., **93**, 1168, **94**, 848.

**Encroachments.**

Improper use of piers by vessel owners, **87**, 802.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, ii, 41, iii, 21, 31; **67**, 43; **68**, 63; **69**, 53; **70**, 71; **71**, 78; **72**, 75; **73**, 80; **74**, 91; **75**, 97; **76**, 59; **77**, 54; **80**, 93; **81**, 120; **82**, 120; **83**, 118; **84**, 128; **85**, 120; **86**, 117; **87**, 79; **88**, 79; **89**, 98; **90**, 88; **91**, 113; **92**, 114; **93**, 123; **94**, 112; **95**, 126; **96**, 114; **97**, 146; **98**, 149; **99**, 171; **1900**,

ENGINEERS IN CHARGE:

Lt. Col. C. S. Stewart assigned charge July 21, 1866, **66**, ii, 41, iii, 21. Reports, **66**, iv, 221; **67**, 431, 434; **68**, 697; **69**, 380.

Lt. Col. J. D. Kurtz, 1870–77. Reports, **70**, 424; **71**, 686; **72**, 778; **73**, 865; **74**, ii, 135; **75**, ii, 181; **76**, 270; **77**, 262.

Col. J. N. Macomb, 1877–82. Reports, **78**, 436; **79**, 444; **80**, 583; **81**, 764.

Capt. W. Ludlow, 1882–83. Report, **82**, 750.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 616.

Maj. W. H. Heuer, 1884–85. Report, **84**, 814.

Lt. Col. H. M. Robert, 1885–90. Reports, **85**, 839; **86**, 832; **87**, 802; **88**, 701; **89**, 866.

Maj. C. W. Raymond, 1890–. Reports, **90**, 886; **91**, 1072; **92**, 929; **93**, 1168; **94**, 848; **95**, 1061; **96**, 918; **97**, 1213; (Lt. Col.), **98**, 1093; **99**, 1344; **1900**, 1574.

ASSISTANTS:

T. Valentine. Reports, **75**, ii, 182; **78**, 436; **79**, 444.

Lt. A. M. D'Armit. Report, **93**, 1169.

**Estimates.** (See *Plans* and *Projects.*)

By Maj. Stewart, completion, $94,000, **66**, iii, 22, 31, iv, 222, 223.

**Operations.**

**1867–68.** 2 bridges connecting pier heads and wharves have been built, 2 cribs sunk, and 2 more nearly ready. Wharves and pier head reconstructed. **68**, 63, 697, 698.

**1868–69.** Have progressed very slowly on account of the inefficiency of one of the contractors. Two cribs have been sunk and the wood-work of those sunk last year completed. **69**, 53, 380.

**1869–70.** 297 c. y. of hammered face stone and 895 perches rubble backing received and placed in position, **70**, 71, 424.

**1870–71.** Closed by completion of the ice piers; description of the work, **71**, 78, 687.

**1871–72.** Iron ladders were attached to each pier, **72**, 778.

**1872–73.** Heavier ladders substituted and placed in recesses cut in the piers, **73**, 80, 865.

**1874–75.** Repairs to piers and bridges, **75**, 97, ii, 181.

## MARCUS HOOK HARBOR, PA.—Continued.

**1875-76.** Repairs to the lower outer ice pier, **76,** 59, 270. History of operations since, 1867, **79,** 444.

**1877-78.** Minor repairs only, **78,** 60, 436.

**1878-79.** Thorough repairs to the piers; connecting bridges rebuilt and dredging to 18 f., **79,** 73, 444.

**1880-81.** 7 clusters of mooring piles driven along inner line of harbor, **81,** 765.

**1881-82.** Repairs to landing piers, **82,** 750.

**1882-83.** Crib superstructure for pier No. 7 sunk, **83,** 616.

**1883-84.** Pier No. 7 completed and reconstruction of pier No. 5 commenced, **84,** 814.

**1884-85.** Pier No. 5 reconstructed, **85,** 839.

**1885-86.** 34,000 c. y. dredged and two groups of mooring piles placed, **86,** 832, 833.

**1886-87.** Construction of crib substructure for pier No. 6, **87,** 802.

**1887-88.** 58,000 c. y. dredged from shoal area at lower end of harbor; proposed new pier completed; pile foundations of pier No. 6 removed, and two groups of mooring piles placed between existing piers, **88,** 702.

**1888-89.** 100,000 c. y. dredged and landing piers repaired, **89** 867.

**1892-93.** 7 mooring piles were replaced and 1 repaired, and repairs were made to two piers, **93,** 1168.

**1893-94.** 2 landing piers were repaired and 1 group of mooring piles placed in harbor, **94,** 849.

**1895-96.** 3 groups of mooring piles were driven and 1 group repaired, **96,** 919.

**1897-98.** 2 landing piers were repaired, **98,** 1093.

**Physical characteristics.**
**66,** iv, 221; **75,** ii, 182.

**Plans.** (See *Estimates* and *Projects.*)
To extend a branch of the Chester & Delaware R. R. on to the piers. Report of officer in charge, assistant engineer, and letter of Wm. Ward. **75,** ii, 181, 182, 183.

**Private work.**
The citizens repaired pier and wharf to prevent their entire destruction, **66,** iv, 221.

**Projects.** (See *Estimates* and *Plans.*)
The original project of 1866, with the amendments thereto, proposed a harbor for the protection of vessels against moving ice by the construction of stone piers behind which vessels could anchor, and the building of a bulkhead about 1,800 f long, parallel with the shore line and about 150 f. outside of high-water line, together with the deepening, by dredging, of the area behind the piers and in front of the bulkhead, **86,** 117. Total amount appropriated from 1829 to 1886, inclusive, $199,000; amount required to complete project, $3,000, **86,** 833.

By Lt. Col. Robert, 1888, excavation of the harbor to 24 f. m. l. w. outside the line running midway between each pair of ice piers; from this line gradually diminishing to 18 f. along the line running midway between the inner ice piers and the landing piers, gradually diminishing to 12 f. on the line joining the head of the landing piers, from which latter line the bottom would take a gentle slope of about one on six until it reaches the natural bottom. Amount of dredging required, about 100,000 c. y. The project also provided for the reconstruction of the upper courses upon two of the U. S. landing piers; estimate, $20,000. **89,** 867.

**Surveys.**
By Col. Macomb, **79,** 444.
Examination made under the direction of Maj. Raymond, 1895-96, **95,** 1061; **96,** 919.
MAPS. Plan of ice harbor, **79,** 444; **88,** 702.

## MARE ISLAND STRAIT, CAL. (See *Napa River.*)

**Commerce.**
Mare Island Navy-Yard requires unobstructed access for all classes of vessels, **97,** 3353.

**Engineers.**
CHIEF OF ENGINEERS. Report, **97,** 488.
ENGINEER IN CHARGE. Maj. C. E. L. B. Davis, 1896-97. Report, **97,** 3352.

**Physical characteristics.**
Description of, **97,** 3354.

**Projects.**
In 1896 Maj. Davis estimated it would cost $318,950 to improve the strait as recommended by the Secretary of the Navy, **97,** 3352.

**Surveys.**
Survey ordered by act of June 3, 1896, made, 1896, by Maj. Davis (see *Projects*), **97,** 3352.

**MARINE CITY, MICH.** (See *Belle River, Mich.*)

**MARQUETTE BAY.** (See *Presque Isle Point, Mich.*)

**MARQUETTE BAY AND HARBOR, MICH.**

**Appropriations.**

1867, $85,000, **67**, 21.
1869, 26,730, allotted, **69**, 22.
1870, 25,000, **70**, 34.
1871, 60,000, **71**, 31.
1872, 50,000, **72**, 30.
1873, 15,000, **73**, 32.
1874, 15,000, **74**, 37.
1875, 15,000, **75**, 41.
1876, 2,000, **76**, 94.
1878, 2,000, **78**, 113.
1879, 1,500, **79**, 152.
1880, 1,000, **80**, 1901.
1882, 16,000, **82**, 2116.
1884, 5,000, **84**, 1829.
1886, 10,000, **86**, 448.
1888, 25,000, **88**, 1831.
1890, 40,000, **90**, 2302.
1892, 80,000, **91**, 2144.
1894, 30,000, **95**, 2572.
1896, 29,000, **96**, 2366.
1899, 25,000, **99**, 2716.

Total, 558,230.

**Commerce.**

Benefits of improvement to commerce, **66**, iv, 78; **67**, 67; **69**, 25; **71**, 31; **75**, 189; **76**, ii, 332, 334.

Effect of fire, 1868; loss, $1,500,000, **68**, 97; **76**, ii, 332.

Local interests, **67**, 66, 67; **70**, 92; **75**, 190; **76**, ii, 331, 334.

Memorial to Congress requesting protection of harbor, **76**, ii, 332.

In the 20 years preceding 1897 the port clearances amounted to about $80,000,000, **98**, 2252.

In the 22 years ending 1899 commerce was valued at $95,000,000, **1900**, 3607.

**Contracts.**

**1867.** W. Ferguson, constructing breakwater, **67**, 57, 69; **68**, 95; **69**, 24. P. White, constructing breakwater, **67**, 69. Gelly & Weston, framing, **68**, 95; **76**, ii, 333; contract annulled and awarded to W. Ferguson, **67**, 69.

**1869.** Hart & Jennings, constructing breakwater, **69**, 24, 72; **76**, ii, 333; contract extended, **76**, ii, 333.

**1870.** J. Caldwell, constructing breakwater, **71**, 109.

**1871.** S. Adams, constructing breakwater, **71**, 109.

**1875.** E. Powell, constructing breakwater, **75**, 189. H. J. Lutes, constructing breakwater, **76**, ii, 330, 333.

**1889.** Morrison & Hannah, breakwater construction, substructure $92.90 and superstructure $17.10 per running foot, **89**, 2022.

**1891.** C. Berner, crib breakwater construction, $28,080, **91**, 2508.

**1892.** Powell & Mitchell, extension and repair of breakwater, $65,351.50, **93**, 2688.

**1894.** Same firm, breakwater extension, $5,745, **94**, 2036.

**1895.** Donohue & Anderson, cement warehouse, $1,000, **95**, 2573. Sandusky Portland Cement Co., Portland cement, $2.20 per bbl. Milwaukee Cement Co., natural cement, $1.04 per bbl. A. & D. Sang, sand, 50 cents per c. y.; broken stone, $1.58 and $2.25 per c. y. Powell & Mitchell, ironware, etc. **95**, 2573

Itemized expenditures for constructing concrete breakwater, **96**, 2377, **97**, 2636, **98**, 2257.

**1899.** W. T. Berthelet, 3,700 bbls. cement, $1.04 per bbl. N. D. Hodgkins, 2,800 c. y. broken stone, $1.60 per c. y. Kelley Island Lime & Transport Co., 800 bbls. cement, $2.35 per bbl. Various circular letter contracts. **99**, 2716.

**Encroachments.**

Upon harbor area by dock owners, **87**, 1996.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, iii, 8; **67**, 21; **68**, 28; **69**, 24; **70**, 34; **71**, 31; **72**, 30; **73**, 31; **74**, 37; **75**, 41; **76**, 94; **77**, 98; **78**, 113; **79**, 151; **80**, 202; **81**, 272; **82**, 267; **83**, 275; **84**, 274; **85**, 297; **86**, 291; **87**, 257; **88**, 1831; **89**, 272, 366, 2027, 2031, 2038; **90**, 245; **91**, 315; **92**, 300; **93**, 342; **94**, 313; **95**, 350; **96**, 306; **97**, 391; **98**, 383; **99**, 453; **1900**, 519.

BOARD OF ENGINEERS. Convened at Marquette, November 27, 1888, by S. O. No. 64, to report upon the establishment of harbor lines in Marquette Harbor, Mich. Report, **89**, 2032. (Majs. Davis, Allen, and Quinn.)

ENGINEERS IN CHARGE.

Maj. W. F. Raynolds, 1866. Reports, **66**, iv, 77; **67**, 256.

Maj. J. B. Wheeler, 1866–70. Reports, **67**, 66; **68**, 94.

Maj. D. C. Houston, 1870–75. Reports, **70**, 92; **71**, 108; **72**, 113; **73**, 195; **74**, 137.

Maj. H. M. Robert, 1875–83. Reports, **75**, 189; **76**, ii, 330; **77**, 851; **78**, 1140; **79**, 1482; **80**, 1900; **82**, 2037; **82**, 2115.

Maj. J. W. Barlow, 1883. **83**, 1629.

Capt. F. A. Hinman, 1883–84. Report, **83**, 1633.

Lt. Col. J. W. Barlow, 1884-86. Reports, **84**, 1829; **85**, 1971.

Capt. W. L. Marshall, 1886. **86**, 290.

Capt. E. L. B. Davis, 1886–89. Reports, **86**, 1645; **87**, 1995; (Maj.) **88**, 1831.

Maj. J. B. Quinn, 1889–91. Reports, **89**, 2021, 2027, 2028, 2039; **90**, 2300.

## MARQUETTE BAY AND HARBOR, MICH.—Continued.

Capt. W. L. Fisk, 1891-92. Reports, **91**, 2505; **92**, 2142.

Maj. C. B. Sears, 1893-. Reports, **93**, 2686; **94**, 2035; **95**, 2571; **96**, 2365; **97**, 2615; **98**, 2252; **99**, 2715; **1900**, 3606.

ASSISTANTS.

Lt. J. B. Quinn. Report, **67**, 67.

W. H. Hearding. Reports, **68**, 94; **74**, 138; **75**, 189.

Capt. J. W. Cuyler. Report, **73**, 195.

R. S. Littlefield, **68**, 95.

C. Coleman. Reports, **96**, 2367; **97**, 2618; **98**, 2254.

**Estimates.** (See *Projects.*)

By Maj. Raynolds, 1866, crib breakwater; first location, $385,129.58 (the one chosen, **67**, 67), **66**, iii, 8, iv, 81; **76**, ii, 332; second location, $279,764.10, **66**, iv, 82.

By Maj. Robert, 1875, extension of breakwater 400 l. f. in 33 f. of water, estimate, $68,000, **75**, 189; **78**, 1140; **79**, 1482. Breakwater extended 10 f. beyond originally proposed length for about $92,000 less than original estimated cost, **76**, ii, 330; **79**. 1482.

**Expenditures.**

For repairs to breakwater, **76**, ii, 331; **77**, 852; **78**, 113, 1141.

**Operations.**[a]

**1867-68.** 100 l.f. stone pier and 210 l. f. crib pier built; 1 crib sunk through the ice, **68**, 95; **76**, ii, 332.

**1868-69.** 450 l. f. crib pier and 160 l. f. superstructure built; 3 cribs sunk through the ice; bottom hard and level, **69**, 24, 25; **76**, ii, 332.

**1869-70.** 200 l. f. crib pier and 450 l. f. superstructure built, **76**, ii, 333.

**1870-71.** 250 l. f. crib pier and 300 l. f. superstructure built, **70**, 34, 92; **76**, ii, 333.

**1871-72.** 550 l. f. crib pier and 300 l. f. superstructure built, **72**, 144; **76**, ii, 333.

**1872-73.** 200 l. f. crib pier and 500 l. f. superstructure built; 741 cords riprap placed; pier supplied with stone; decking begun, **73**, 195; **76**, ii, 333.

**1873-74.** 150 l. f. superstructure built; 311 cords riprap placed; decking completed except on last 150 ft. of pier; cribs refilled, **76**, ii, 333.

**1874-75.** 50 l. f. crib pier and 100 l. f. superstructure built; 333 cords riprap placed; cribs sunk on a stone foundation 7½ feet high, **75**, 189; **76**, ii, 333, 334.

**1875-76.** 50 l. f. superstructure built; 2,059 cords riprap placed; pier riprapped; decking completed by hired labor; minor repairs, **76**, 94, ii, 330.

**1876-77.** Minor repairs, **77**, 98, 851.

**1877-78.** Repairs to breakwater, **78**, 113, 1140.

**1879-80.** Repairs to breakwater, **80**, 1900.

**1880-81.** Repairs to breakwater, **81**, 3037.

**1881-82.** Extensive repairs to breakwater, **82**, 2116.

**1882-83.** 1,050 l. f. of breakwater repaired and renewed, **83**, 1634.

**1883-84.** Repairs to breakwater, **84**, 1829.

**1886-87.** 200 f. of breakwater riprapped; 315 f. of superstructure rebuilt; damage to breakwater and pier-head light repaired, **87**, 1995.

**1887-88.** Repairs to breakwater made by hired labor, **88**, 1831.

**1889-90.** 180 l. f. of breakwater built, **90**, 2300.

**1890-91.** Repairs to superstructure, **91**, 2506.

**1891-92.** Breakwater extension in progress; repairs to superstructure, **92**, 2143.

**1892-93.** Breakwater extension in progress, **93**, 2686.

**1893-94.** In connection with previous year, 600 l. f. breakwater completed, **94**, 2035.

**1894-95.** In connection with preceding year, 100 l. f. added to breakwater, and construction of concrete breakwater begun, **95**, 2571.

**1895-96.** In connection with preceding year, 470 l. f. concrete breakwater built, and cement for the same tested, **96**, 2365, 2376.

**1896-97.** 390 l. f. concrete breakwater built, and the cement used tested, **97**, 2616, 2623, 2627.

**1897-98.** 140 l. f. breakwater completed. Cement tested, **98**, 2252, 2269.

**1899-1900.** 500 ft. of extension to concrete superstructure built, **99**, 2715; **1900**, 3606.

**Physical characteristics.**

Description of, **71**, 109; **76**, ii, 331; **96**, 2365; **97**, 2615.

Character of substratum, as determined by borings taken in 1869 on line of pier, **76**, ii, 333.

**Private work.**

Pending a reconsideration of the established harbor lines by the Secretary of War, the Duluth, South Shore and Atlantic Railway extended its ore dock beyond the established lines, **93**, 2687.

**Projects.** (See *Estimates.*)

By Maj. Raynolds, 1866, crib breakwater, north side of harbor, southerly, 2,000 l. f., in four sections of 500 f. each, respectively (beginning at shore

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[a] 1875. Project completed; breakwater 2,010 f. long; cost of work compared with original estimate of 1866, 76, ii, 330; 77, 851; 79, 1482. History of operations, 76, ii, 331. Abstracts of materials used and work done, 67, 69; 68, 97; 76, ii, 331.

**MARQUETTE BAY AND HARBOR, MICH.**—Continued.

end), 25, 30, 35, and 40 f. in width; entire structure when completed to be 5 feet above the water, filled with ballast and decked, **66**, iv, 79, 80, 82; estimate, $385,129.58, **66**, iii, 8, iv, 81; **76**, ii, 332. In 1875 the breakwater was completed to a length of 2,010 f. (or 10 f. beyond original estimate), at a cost of $92,000 less than originally estimated, **76**, ii, 330; **79**, 1482; **86**, 291.

By Maj. Robert, 1875, farther extension of breakwater 400 f.; estimate (not in addition to original estimate), $68,000, **75**, 189; **79**, 1482; **86**, 282.

In 1888 Maj. Davis provided for the extension of the breakwater for a distance of 1,200 f.; estimate, $200,000, **88**, 1831.

In 1889 the length of the projected breakwater was reduced by Maj. Quinn to 1,000 f., at a cost of $121,000, **89**, 2021.

In 1890 Maj. Quinn proposed the addition of a concrete superstructure to the 2,000 l. f. of breakwater built under the project of 1866; estimate, $149,454.36. This, together with the cost of breakwater extension as projected in 1889, made a total of $270,454.36 for completion in 1890, **90**, 2301.

On experience in building first 1,000 f. of breakwater, it was estimated, 1899, that $100,000 instead of $173,936.71 would be required to complete project, **99**, 2715.

**Surveys.**

Marquette Harbor, 1859, under direction of Capt. Meade, **67**, 53, 566.

Maps. Of harbor, **76**, ii, 330; **87**, 1998; **96**, 2384; **97**, 2626; **98**, 2256.

**MARTHAS VINEYARD (EDGARTOWN HARBOR), MASS.**

**Appropriations.**

1826, $500 (survey), act May 20.
1829, 2,500, act Mar. 2.
1872, 20,000, **72**, 95.
1890, 2,000, **91**, 699.
1892, 2,500, **92**, 604.
1894, 2,500, **95**, 662.

Total, 30,000

**Commerce.**

Important, **72**, 978; **74**, ii, 209, 215; **75**, ii, 276; **82**, 578.

**Contracts.**

**1895.** Hartford Dredging Co., dredging, 27.5 cents per c. y. ($1,200), **95**, 663.

**Engineers.**

Chief of Engineers. Reports, **72**, 95; **73**, 86; **74**, 96; **75**, 106; **81**, 89; **82**, 89; **89**, 56; **90**, 50; **91**, 49; **92**, 53; **93**, 55; **94**, 51; **95**, 56; **96**, 56; **97**, 68.

Board of Engineers. U. S. advisory council, 1872, cooperating with the harbor commissioners of Massachusetts, approve the plan of the harbor commissioners to reopen the inlet. Report (extract), **74**, ii, 195. (Admiral C. H. Davis, U. S. N., and Profs. Benjamin Pierce and Henry Mitchell, U. S. C. S.)

Engineers in Charge:

Lt. Col. G. Thom, 1872. Reports, **72**, 955, 976.

Maj. G. K. Warren, 1872–82. Reports, **73**, 949; **74**, ii, 182; **75**, ii, 268; (Lt. Col.) **82**, 566.

Maj. W. R. Livermore, 1888–92. Reports, **90**, 585; **91**, 698.

Capt. W. H. Bixby, 1892–95. Reports, **92**, 602; **93**, 809; **94**, 576; **95**, 661.

Maj. D. W. Lockwood, 1896–97. Reports, **96**, 629; **97**, 890.

Assistants:

S. Haagensen. Report, **72**, 979.

H. S. Van Ingen. Reports, **74**, ii, 210; **75**, ii, 272.

**Estimates.** (See *Plans* and *Projects*.)

By S. Haagensen, dredging straight channels, $17,897, $26,473, $45,000; dredging an S-curved channel, $49,306, **72**, 981.

By Maj. Warren, breakwater, jetties, sand catchers, dredging, etc., $220,000, **74**, ii, 208.

By H. S. Van Ingen, jetties, $1,300; dredging, $19,000 and $80,000, **75**, ii, 275.

**Operations.**

**1872–74.** 42,568 c. y. dredged, **73**, 950; **74**, ii, 212.

**1891–92.** 15,385 c. y. dredged, **92**, 603.

**1892–93.** About 10,000 c. y. dredged, **93**, 809.

**1896–97.** About 6,500 c. y. dredged, **97**, 890.

**Physical characteristics**

General, **72**, 980; **74**, ii, 203; **75**, ii, 274, 276, 277; **82**, 567; **90**, 586.

Effect of waves, **72**, 976, 977, 681; **74**, ii, 199, 200, 205, 212.

Discussion of tides, **74**, ii, 189, et seq.

Tidal curves, **74**, ii, 198; **75**, ii, 272.

**Plans.** (See *Estimates* and *Projects*.)

By Prof. H. L. Whiting, to open a channel through Cotamy Beach, **74**, ii, 186.

By S. Haagensen, straight channel with a depth of 4 f. and widths of 100, 200, or 300 f.; dredging an S-curved channel to a depth of 4 f. and width of 300 f. from Cotamy Bay to the ocean, **72**, 981.

By Maj. Warren, to open a channel 300 f. wide and 4 f. deep at the east end of the bay; protection of beach with jetties 50 f. long and 50 f. apart and riprapping; breakwater 300 f. long and 20 f. wide on top; also for sand catchers, **74**, ii, 208.

By H. S. Van Ingen, dredging middle ground to depths of 12 f. or 18 f.; jetties at Cape Poge and south of Cape Poge Pond, **75**, ii, 275.

## MARTHAS VINEYARD (EDGARTOWN HARBOR), MASS.—Continued.

By Lt. Col. Warren, 1882, channel through South Beach 300 f. wide and 6 f. at m. l. w. and the protection of the channel by a pile jetty on the west side of the channel; estimate $39,000, **82**, 578.

By Maj. Livermore, 1889, outer harbor of Edgartown, ice breaker and breakwater of riprap granite; estimate $96,800, **90**, 586.

**Private (State) work.**

Board of harbor commissioners of Massachusetts referred to, **74**, ii, 184; **75**, ii, 269.

**Projects.** (See *Estimates* and *Plans.*)

By Lt. Col. Thom, channel 150 f. wide and 4 f. deep; estimate $22,000, **72**, 978. Failure of the work, **74**, 97.

By Maj. Livermore, 1891, removal of a shoal called "Middle Ground" in the center of the harbor to a depth of 10 f. at m. l. w.; estimate $4,500, **91**, 698; **92**, 603.

By Capt. Bixby, 1893–95, for doing work with hired labor and Government plant, **93**, 809; for expenditure of available funds, dredging to be done by contract, **95**, 662.

**Surveys.**

Included in Coast Survey, 1846–54–56 and 1871, **72**, 980; **74**, ii, 185.

By S. Haagensen. Report, **72**, 979.

By H. S. Van Ingen, 1874. Report, **75**, ii, 272. Comparison between surveys of 1846 and 1871, **74**, ii, 209; 1871 and 1874, **75**, ii, 273.

History of previous surveys, **82**, 568.

Ordered by act of Mar. 3, 1881, made under the direction of Lt. Col. Warren, **82**, 566, 574.

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Livermore, **90**, 587.

MAPS:

Vineyard and Nantucket Sounds, **74**, ii, 192.

Edgartown Harbor, **75**, ii, 276.

Sketch of beach, **74**, ii, 204.

**93**, 810; **95**, 622.

## MASSENA, N. Y. (See *Grass River, N. Y.*)

## MATAGORDA, TEX. (See *Indianola, Passo Cavallo, etc.*)

## MATAGORDA BAY, TEX. Waterway to ARANSAS BAY.[a]

## MATANZAS RIVER, FLA. (See *St. Augustine Harbor.*)

## MATAWAN CREEK, N. J.

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $15,000, | **81**, 720. |
| 1882, | 6,000, | **82**, 707. |
| 1890, | 2,500, | **91**, 1003. |
| 1892, | 9,620, | **92**, 891. |
| 1894, | 3,000, | **95**, 990. |
| 1896, | 3,000, | **96**, 792. |
| 1899, | 3,000, | **99**, 1309. |
| Total, | 42,120 | |

**Contracts.**

**1881.** J. Van Patton, dredging, 48 cents per c. y., **81**, 720.

**1882.** F. Pidgeon, jr., dredging, 59 cents per c. y., **83**, 588.

**1891.** Atlantic Dredging Co., dredging, 37½ cents per c. y., **91**, 1003.

**1893.** A. E. Smith, dredging, 30 cents per c. y., s. m. ($7,600), **93**, 1127.

**1895.** A. E. Smith, dredging, 20 cents per c. y., **95**, 989.

**1896.** J. McSpirit & Sons, dredging 7,600 c. y., 19¼ cents per c. y., b. m., **96**, 791.

**1897.** J. McSpirit, dredging, 18¾ cents per c. y., p. m., ($2,700), **97**, 1147.

**1899.** W. H. Taylor, jr., dredging, 26 cents per c. y., s. m., ($2,700), **99**, 1310.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **80**, **90**; **81**, 113, 115; **82**, 113; **83**, 110; **84**, 119; **85**, 111; **86**, 105; **87**, 74; **88**, 74; **91**, 104; **92**, 107; **93**, 115; **94**, 104; **95**, 117; **96**, 99; **97**, 135; **98**, 140; **99**, 160; **1900**, 183.

ENGINEERS IN CHARGE:

Lt. Col. N. Michler, 1880–81. Report, **81**, 720.

Col. J. Newton, 1881. Report, **82**, 683.

Lt. Col. G. L. Gillespie, 1881–85. Reports, **82**, 706; **83**, 587; **84**, 756; **85**, 763.

Lt. Col. W. McFarland, 1885. Report, **86**, 761.

Lt. G. McC. Derby, 1887–90. Reports, **87**, 777; (Capt.) **88**, 663.

Capt. T. L. Casey, 1890–94. Reports, **91**, 1003; **92**, 890; **93**, 1125; **94**, 816.

Lt. Col. G. L. Gillespie, 1895. Report, **95**, 988.

Maj. H. M. Adams, 1896–97. Reports, **96**, 790; **97**, 1145.

Maj. A. M. Miller. Report, **98**, 1066.

Col. J. W. Barlow, 1899—. Reports, **99**, 1309; **1900**, 1510.

ASSISTANT. A. Doerflinger. Report, **81**, 721.

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[a] Examination—Report (unfavorable), April 18, 1853. (H. Doc. No. 482, 55th Cong., 2d sess.)

## MATAWAN CREEK, N. J.—Continued.

**Operations.**

**1881-82.** 25,630 c. y. removed by dredging, **72**, 706.

**1882-83.** 8,897 c. y. dredged, **83**, 587.

**1891-92.** 5,028 c. y. dredged, **92**, 891.

**1892-93.** 2,617 c. y. dredged, **93**, 1126.

**1893-94.** 22,285 c. y. dredged, **94**, 816.

**1895-96.** 12,404 c. y. dredged, **96**, 791.

**1897-98.** 13,508 c. y. dredged, **98**, 1066.

**1899-1900.** 10,400 c. y. dredged, **1900**, 1510.

**Physical characteristics.**

Description of, **88**, 663.

**Projects.**

By Lt. Col. Michler, 1880, channel 4 f. deep at m. l. w. and 100 f. wide, mouth up to Winkson Creek, 2 miles, to the head of navigation at the Long Branch R. R. bridge, 4 f. deep at m. l. w. and 75 f. wide; estimate, $33,120, **81**, 722; **86**, 762; **91**, 1003.

In 1892 Capt. Casey reported that the estimated cost of the project should be increased by $10,000, **93**, 1126

In 1898 Maj. Miller estimated it would cost $3,000 annually for maintenance, **98**, 1066.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction of Lt. Col. Michler, **81**, 720.

Survey made by Capt. Casey, 1892, **93**, 1126.

## MATINICUS ISLAND, ME.[a]

**Appropriations.**

1852, [b]$1,000.

**Commerce.**

Improvement of Ten-Pound Harbor not warranted, **76**, 194.

Benefit to commerce by the improvement of Matinicus Harbor, **76**, 195.

Availability of place as a harbor of refuge, **76**, 197, 198.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **76**, 48; **87**, 21.

ENGINEERS IN CHARGE:

Lt. Col. G. Thom, 1875. Report, **76**, 194.

Maj. J. A. Smith, 1887. Report, **87**, 475.

ASSISTANT. S. Haagensen. Report, **76**, 196.

**Physical characteristics.**

General, **76**, 195, 196, 198. Tides, **76**, 195, 197; **87**, 476.

**Plans.**

By S. Haagensen, three breakwaters; (1) to inclose area between Matinicus Island, Indian and Dexter ledges, making a harbor for small vessels only; estimate, $36,000; (2) to make a harbor for vessels of all classes; estimate, $300,000; (3) from Curtis Point to Ten-Pound Island, and from Cato Ledge to Ragged Island, to make a harbor of refuge; estimate, $1,114,000, **76**, 196, 197, 198.

**Survey.**

By S. Haagensen, 1875. Report, **76**, 196.

Examination ordered by act of Aug. 5, 1886; made, 1887, under direction of Maj. Smith (report unfavorable), **87**, 475.

## MATTAPONI RIVER, VA.

**Appropriations.**

| | | |
|---|---|---|
| 1880, | $2,500, | **80**, 773. |
| 1881, | 3,300, | **81**, 969. |
| 1884, | 2,500, | **84**, 992. |
| 1886, | 5,000, | **86**, 916. |
| 1888, | 3,000, | **88**, 827. |
| 1890, | 3,000, | **90**, 1073. |
| 1892, | 4,000, | **92**, 1061. |
| 1894, | 4,000, | **95**, 1248. |
| 1896, | 2,500, | **96**, 1061. |
| Total, | 29,800. | |

**Commerce.**

Important, **75**, ii, 168.

Improvement of benefit to commerce. Total freight tonnage in 1894 amounted to 39,300 tons. **97**, 1343.

Description of, **99**, 1434; **1900**, 1723.

**Contracts.**

**1887.** D. A. Gillies, dike construction, **87**, 941.

**1891.** H. T. Morrison & Co., construction of plant, $6,129, **92**, 1060.

**Engineers.**

CHIEF OF ENGINEERS. Report, **75**, 95; **80**, 111; **81**, 155; **82**, 150; **83**, 156; **84**, 158; **85**, 148; **86**, 143; **87**, 109; **88**, 112; **89**, 129; **90**, 116; **91**, 144; **92**, 145; **93**, 156; **94**, 144; **95**, 165; **96**, 151; **97**, 185; **98**, 188; **99**, 218; **1900**, 249.

ENGINEERS IN CHARGE:

S. T. Abert, U. S. agent, 1875-91. Reports, **75**, 95; **80**, 770; **81**, 968; **82**, 1033; **83**, 817; **84**, 991; **85**, 979; **86**, 915; **87**, 940; **88**, 826; **89**, 1012; **90**, 1072.

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[a] Survey—Report Dec. 17, 1852; estimate, $38,275. (H. Doc. No. 482, Fifty-fifth Cong., 2d sess.)

[b] For survey in connection with building a breakwater on the eastern side of the island. (Treasury Doc. 873, 1882.)

## MATTAPONI RIVER, VA.—Continued.

Lt. Col. P. C. Hains, 1891–92. Report, **91**, 1273.

Maj. C. E. L. B. Davis, 1892–95. Reports, **92**, 1059; **93**, 1306; **94**, 966; **95**, 1246.

Maj. C. J. Allen, 1896–. Reports, **96**, 1058; (Lt. Col.), **97**, 1342; **98**, 1206; **99**, 1433; **1900**, 1722.

**Obstructions.**

Description of, **99**, 1433.

**Operations.**

**1880–81.** Derrick, derrick boat, quarter-boat, and scows constructed, **81**, 969.

**1881–82.** 2,016 snags, 1,378 logs and trees, and 4 wrecks removed, cleaning 13 miles of river, **82**, 1034.

**1882–83.** 94 snags, 279 logs and trees, and 1 wreck removed, **83**, 818.

**1886–87.** 242 l. f. of dike built, **77**, 941.

**1887–88.** 1,179 l. f. of pile dike built, and 430 logs, snags, trees, and stumps removed, 29 mats built and sunk, **88**, 827.

**1888–89.** 79 round piles and 2,400 f. B. M. sheet piles driven, and 102 l. f. wall pieces fastened by hired labor, **89**, 1012.

**1889–90.** Dikes already in process of construction finished, and 243 l. f. of additional work built by hired labor, **90**, 1072.

**1891–92.** 165 snags, 27 logs, and 270 overhanging trees removed, **92**, 1060.

**1892–93.** Work of removing snags and similar obstructions in progress, **93**, 1307.

**1893–94.** 66 snags, 41 drift logs, and 16 overhanging trees removed, **94**, 967.

**1894–95.** 29 snags, 14 logs, and 5 overhanging trees removed, **95**, 1247.

**1899–1900.** 24 snags, 4 logs, and a sunken ferry scow removed, **1900**, 1723.

**Physical characteristics.**

Description of, **75**, ii, 166, 167, 168, 169; **80**, 771; **98**, 1206.

List of obstructions, **75**, ii, 167, 168; **80**, 771.

**Plans.**

By S. T. Abert, 1875, removal of obstructions and closing secondary channels; estimate, $34,059, **75**, ii, 169, 170.

**Projects.**

By S. T. Abert, 1875, removal of snags and wrecks, and excavation of channel from head of navigation to Line Tree Bar, having a width of 40 f. and a depth of 5½ f. at l. w.; estimate, $34,059, **75**, ii, 169, 170.

In 1884 S. T. Abert proposed, in addition to the previous project, dikes at Robinson and Latanes bars; estimate, $38,000, **85**, 979; **86**, 143, 916; **87**, 941.

Congress, 1892, provided that $1,500 of the $4,000 appropriated in that year should be expended between Ayletts and Guineas bridges, **93**, 1307. A similar provision was made in 1894, **95**, 1247.

By Maj. Davis, 1894, expenditure of available funds in making such surveys as might be required in dredging and removing obstructions and in repairing dikes, the dredging to be done by contract, other work by hired labor and the use of the Government plant, **95**, 1247.

**Surveys.**

By Col. Crozet, 1828, **75**, ii, 166.

Examination made, 1874, **75**, 95.

Surveys were made, 1895–96, by Maj. Davis, **95**, 1247; **96**, 1060.

Examination of Line Tree and Latana bars made by Lt. Col. Allen, 1897, **97**, 1342.

MAPS. **85**, 980; **87**, 941; **88**, 827.

## MATTITUCK BAY AND HARBOR, N. Y.

**Appropriations.**

1896, $10,000, **96**, 735.
1899, 5,000, **99**, 1220.

Total, 15,000

**Commerce.**

Not unimportant, **91**, 846.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **91**, 80; **96**, 85; **97**, 119; **98**, 115; **99**, 129; **1900**, 147.

ENGINEERS IN CHARGE:

Col. D. C. Houston. Report, **91**, 843.

Maj. H. M. Adams, 1896–98. Reports, **96**, 734; **97**, 1095; **98**, 1001.

Lt. Col. W. H. H. Benyaurd, 1899. Report, **99**, 1219.

Maj. E. H. Ruffner, 1900–. Report, **1900**, 1392.

**Physical characteristics.**

Description of, **91**, 843.

**Projects.**

By Col. Houston, 1891, channel 7 f. deep at low tide, Long Island Sound up to the tide mill at Mattituck, 100 f. wide at the entrance, thence to the mill to be 80 f. wide, the entrance channel to be secured with parallel jetties extending from the shore out to the 9-f. curve in Long Island Sound; estimate $83,000; **91**, 845; **96**, 734.

By Maj. Adams, 1897, for retaining funds intact until a large enough sum had been appropriated to complete at least one of the jetties, **97**, 1096.

**Surveys.**

Examination ordered by act of September 19, 1890; made, 1890, under direction of Col. Houston, **91**, 843.

## MATTOX CREEK, VA.

**Engineers.**
Chief of Engineers. Report, **87**, 114.

Engineer in Charge. S. T. Abert, U. S. agent, 1886. Report, **87**, 959.

**Physical characteristics.**
Description. Sufficient depth of water. **87**, 959.

**Survey.**
Examination ordered by act of Aug. 5, 1886; made, 1886, under direction of S. T. Abert (report unfavorable), **87**, 959.

## MAUMEE BAY, OHIO. (See *Toledo Harbor.*)

## MAUMEE RIVER (above Toledo), OHIO.[a] (See *Toledo, Ohio.*)

**Appropriations.**
1872, $7,000, **72**, 225.

**Commerce.**
Important, **72**, 235, 236.

Toledo, situated on the river, has a large commerce; in 1896 the registered tonnage amounted to over 2,250,000 t., **98**, 2701.

**Contract.**
**1872.** H. F. Stock & Co., dredging, 25 cents per c. y., **73**, 324, 325.

**Engineers.**
Chief of Engineers. Reports, **71**, 48; **72**, 43, 45; **73**, 42; **81**, 314; **98**, 453.

Engineers in Charge:
Capt. G. L. Gillespie, 1871. Reports, **72**, 225, 235.
Maj. F. Harwood, 1873. Report, **73**, 324.
Maj. J. M. Wilson, 1881. Report, **81**, 2341.
Col. J. A. Smith, 1898. Report, **98**, 2693.

Assistant. W. T. Blunt. Report, **98**, 2701.

**Estimates.** (See *Plans* and *Projects.*)
By Maj. Gillespie, 8-f. channel, Toledo to Maumee, $7,000, **72**, 237.

By Maj. Harwood, 1873, to complete channel, Perrysburg to Maumee City, $15,000, **73**, 324, 325.

**Operations.**
**1872–73.** 23,159 c. y. dredged, making channel for vessels drawing 7 f. of water, Toledo to Perrysburg, **73**, 324, 325.

**Physical characteristics.**
Description of, **72**, 236, 237; **81**, 2341; **98**, 2694.

**Plans.** (See *Estimates* and *Projects.*)
By Maj. Wilson, 1880, channel 100 f. wide and 8 f. deep at low water, Perrysburg to Toledo, by dredging, rock removal, and dike construction; estimate, $124,748, **81**, 2342.

**Private (State) work.**
Canal embankment built by the State of Ohio, in 1840–41, an injury to the channel, **73**, 42.

**Projects.** (See *Estimates* and *Plans.*)
By Maj. Gillespie, channel 60 f. wide and 8 f. deep, Maumee City to Perrysburg, and deepening existing channel over Delaware Flats, **72**, 225.

By Maj. Harwood, channel for vessels drawing no more than 7 f., Toledo to Maumee City, **73**, 42.

In 1897 Col. Smith estimated it would cost $1,095,000 to obtain a width of 400 f. at depth of 21 f. at mean level throughout the channel in the bay and river; this cost could also be reduced probably by $90,000, **98**, 2693.

**Surveys.**
Examination and survey ordered by act of Mar. 3, 1871, **71**, 48; made by Capt. G. L. Gillespie. Report, **72**, 235.

Ordered by act of June 14, 1880; made under direction of Maj. Wilson, 1880, **81**, 2341.

Survey of the straight channel in Maumee Bay and River ordered by act of June 4, 1897, made under the direction of Col. Smith, 1897 (see *Projects*), **98**, 2693.

Maps. **98**, 2704.

## MAURICE RIVER, N. J.

**Appropriations.**

| | | |
|---|---|---|
| 1882, | $3,000, | **83**, 639. |
| 1884, | 17,000, | **84**, 836. |
| 1886, | 5,000, | **86**, 856. |
| 1888, | 10,000, | **88**, 738. |
| 1890, | 8,000, | **90**, 916. |
| Total, | 43,000 | |

**Commerce.**
Important, **83**, 640.

Increase in amount of shipping consequent upon improvement, **88**, 739.

Description, **1900**, 1607, 1608.

**Contracts.**
**1885.** American Dredging Co., dredging, 15 cents per c. y., **85**, 868.

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[a] Survey—Report, Feb. 12, 1836, estimate $21,682.88 (H. Doc. No. 482, 55th Cong., 2d sess.).

## MAURICE RIVER, N. J.—Continued

**1889.** American Dredging Co., dredging, 15 cents per c. y., **90**, 916.

**1891.** American Dredging Co., dredging, 19 cents per c. y., **91**, 1089.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **81**, 129; **82**, 126; **83**, 125; **84**, 134; **85**, 127; **86**, 124; **87**, 86; **88**, 86; **89**, 102; **90**, 92; **91**, 117; **92**, 119; **99**, 182; **1900**, 207.

ENGINEERS IN CHARGE:

Capt. W. Ludlow, 1882–83. Report, **82**, 809.

Lt. Col. G. Weitzel, 1883–84. Report, **83**, 639.

Maj. W. H. Heuer, 1884–85. Report, **84**, 836.

W. F. Smith, U. S. agent, 1885–91. Reports, **85**, 868; **86**, 855; **87**, 826; **88**, 738; (Maj.) **89**, 880; **90**, 916.

Maj. C. W. Raymond, 1891–. Reports, **91**, 1089; **92**, 938; (Lt. Col.), **1900**, 1605, 1610.

ASSISTANTS.

E. A. Gieseler. Report **82**, 812.

J. J. Lee. Report, **83**, 639.

A. Stierle. Report, **84**, 837.

**Operations.**

**1885–86.** 110,015 c. y. dredged from various points in the channel between Millville and the mouth, **86**, 856.

**1887–88.** 29,363 c. y. dredged from the channel, **88**, 738.

**1889–90.** 49,918 c. y. dredged, **90**, 916.

**1890–91.** 6,785 c. y. dredged, **91**, 1088.

**1891–92.** 37,392 c. y. dredged, **929**, 939.

**Physical characteristics.**

Description of, **82**, 812; **1900**, 1606.

**Projects.**

By Capt. Ludlow, 1882, Millville to mouth, channel 100 f. wide and 4 f. deep at m. l. w., beginning 2¼ miles below the bridge at Millville, to a point called Pea Landing; also a cut of the same width and depth through a point of land at Silver River; Pea Landing to the bridge, the channel to be 4 f. deep and 50 f. wide for 400 f. above the bridge, the 100 f. width to be resumed, being reduced to 50 f. for the next 500 f. length; estimate $114,500, **82**, 811; **85**, 868; **87**, 86; **92**, 938.

Lt. Col. Raymond estimated, 1899, it would cost $98,000 to improve river from below Frenchs Bar to head of navigation, **1900**, 1605.

**Surveys.**

Ordered by act of Mar. 3, 1881, made, 1882, under direction of Col. Macomb, **82**, 809.

Examination and survey, ordered by act of Mar. 3, 1899, made, 1899–1900, by Lt. Col. Raymond (report favorable) (see *Projects*), **1900**, 1606, 1610.

## MAYSVILLE, KY. (See *Ohio River*.)

## MEADOW RIVER, W. VA.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 253, **88**, 226.

ENGINEER IN CHARGE. Col. W. P. Craighill, 1886. Report, **88**, 1761.

ASSISTANT. N. H. Hutton. Report, **88**, 1762.

**Physical characteristics.**

Description of, **88**, 1761.

**Plans.**

By Col. Craighill, 1887, for clearing Meadow River to facilitate the rafting of logs; estimate, $45,000, **88**, 1762.

**Surveys.**

Examination ordered by act of Aug. 5, 1886, **87**, 253; made, 1887, under direction of Col. Craighill, **88**, 1762.

MAPS. **88**, 1762.

## MEDOMAC RIVER, ME.

**Commerce.**

Unimportant, **85**, 549.

**Engineers.**

CHIEF OF ENGINEERS. Report, **89**, 31.

ENGINEER IN CHARGE. Lt. Col. J. A. Smith, 1888. Report, **89**, 549.

**Physical characteristics.**

Description of, **89**, 549.

**Surveys.**

Examination ordered by act of Aug. 11, 1888, made, 1888, under direction of Lt. Col. Smith (report unfavorable), **89**, 549.

**MEEKERS ISLAND.** (See *Mississippi River, Meekers Island Lock and Dam.*)

## MEHERRIN RIVER, N. C.

**Appropriations.**
1882, $5,000; **83**, 846.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **81**, 168; **82**, 163; **83**, 163; **84**, 166; **85**, 160; **86**, 155; **87**, 121.

ENGINEERS IN CHARGE:
Col. W. P. Craighill. 1888. Report, **88**, 773.
Capt. J. Mercur, 1881–84. Reports, **82**, 1114; **83**, 846.
Capt. F. A. Hinman, 1884–87. Reports, **84**, 1034; **85**, 1041; **86**, 965; **87**, 989.
ASSISTANT. C. M. Yeates. Report, **82**, 1115.

**Operations.**
**1882–83.** Removing obstructions begun, **83**, 846.
**1883–84.** 1,072 trees, logs, snags, and piles, and 296 overhanging trees removed from the river between mouth and Murfreesboro, **84**, 1034.
**1884–85.** 119 snags, log, and treess removed, **85**, 1041.

**Projects**
By Capt. Mercur, 1882, for removing snags and similar obstructions to secure a 9-f. channel 80 f. in width, mouth to Murfreesboro; estimate, $125,000, **82**, 1115.
In 1888, no permanent benefit to be derived from the improvement, **88**, 773.

**Surveys.**
Examination ordered by act of Mar. 3, 1881, made, 1882, under direction of Capt. Mercur, **82**, 1114.

**MEMPHIS, TENN.** (See *Mississippi River.*)

**MEMPHREMAGOG LAKE.** (See *Connecticut River.*)

**MEMPHREMAGOG LAKE CANAL.** (See *Champlain Lake.*)

## MENDOCINO BAY (HARBOR), CAL. (See *Pacific Coast, Harbor of Refuge.*)

**Commerce.**
Description of; in 1895 it was estimated that the cost of constructing breakwaters for an improvement of the harbor would be greater than the benefits that would be derived by commerce, **95**, 3330, 3331.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **77**, 123; **95**, 440.
BOARD OF ENGINEERS. For the Pacific coast met Aug., 1876, to examine the harbors of Mendocino, Humboldt Bay, Trinidad, and Crescent City, Cal., with a view of establishing a breakwater and harbor of refuge. The board reported that a harbor of very limited capacity could be built. Report, **77**, 1052. (Lt. Cols. Williamson, Alexander, and Stewart, and Maj. Mendell.)
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1895. Report, **95**, 3330.
ASSISTANT. Lt. H. Deakyne. Report, **95**, 3331.

**Estimates.**
By Board of Engineers, breakwater, $3,455,100, **77**, 1058.

**Physical characteristics.**
Description of. Situated nearly midway between San Francisco and Humboldt bays. A safe harbor during northwest storms, but unsafe in winter. **95**, 3330.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made, 1895, under the direction of Maj. Heuer (report unfavorable), **95**, 333.

## MENEMSHA (BITE OR BIGHT) HARBOR, MASS.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **87**, 43; **91**, 62; **92**, 66.

ENGINEERS IN CHARGE:
Lt. Col. G. H. Elliot, 1886. Report, **87**, 569.
Maj. W. R. Livermore. Report, **92**, 642.

**Physical characteristics.** (See *Plans.*)

Description of, **87**, 570; **92**, 642.

**Plans.**
By Maj. Livermore, 1891, for confining the current and producing a scour across the bar with brush and stone jetties extending out from the banks on either side of the mouth of the outlet to 10 f. of water in the bight; estimate, $20,000. In view of the uncertainty of maintenance and the present demands of commerce, Maj. Livermore considered the expediency of the improvement doubtful. **92**, 645.

**Surveys.**
Examination ordered by act of Aug. 5, 1886, made, 1886, under direction of Lt. Col. Elliot (report unfavorable) (see *Plans*), **87**, 569.

## MENOMINEE HARBOR, MICH. AND WIS.

**Appropriations.**

| | | |
|---|---|---|
| 1871, | $25,000, | **71**, 32. |
| 1872, | 25,000, | **72**, 31. |
| 1873, | 25,000, | **73**, 32. |
| 1874, | 25,000, | **74**, 37. |
| 1875, | 25,000, | **75**, 42. |
| 1876, | 8,000, | **76**, 95. |
| 1878, | 10,000, | **78**, 113. |
| 1879, | 10,000, | **79**, 152. |
| 1880, | 10,000, | **80**, 1903. |
| 1881, | 12,000, | **81**, 2059. |
| 1882, | 15,000, | **82**, 2127. |
| 1884, | 10,000, | **84**, 1837. |
| 1886, | 3,000, | **86**, 1653. |
| 1888, | 9,000, | **88**, 1838. |
| 1894, | 10,000, | **95**, 2597. |
| 1896, | 7,150, | **96**, 2461. |
| 1899, | 5,500, | **99**, 2726. |

Total, 234,650.

**Commerce.**

Local interests, **67**, 132, 133; **73**, 197.

Important, **67**, 134; **75**, 193; **76**, ii, 338.

A freight ferry, to ply across Green Bay and Lake Michigan, established, 1894, with a terminus at this place. **95**, 2596.

**Contracts.**

**1871.** A. Kirby, materials and lobor, **71**, 110.

**1873.** A. Kirby, materials and labor, **74**, 138.

**1874.** Menomonee Dredge Co., dredging, 25 cents per c. y., **74**, 138. Green Bay Dredge & Pile-Driver Co., construction of pile pier, **75**, 192.

**1875.** Menomonee Dredge Co., dredging, 14½ cents per c. y., **75**, 93; contract extended, **76**, ii, 334.

**1877.** Truman & Schrœder, materials and labor, **77**, 852.

**1878.** Menomonee Dredge Co., dredging, 10 cents per c. y., **78**, 1142. Green Bay Dredge & Pile-Driver Co., materials and labor, **79**, 1484.

**1880.** Green Bay Dredge & Pile Driver Co., pier extension, **80**, 1904. Truman & Cooper, pier extension, **81**, 2060.

**1881.** Green Bay Dredge & Pile Driver Co., pier extension, **81**, 2060.

**1882.** S. M. Stephenson, dredging, 10 cents per c. y., **83**, 1640. Truman & Cooper, pier extension, substructure and superstructure construction, **83**, 1641.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **67**, 27; **71**, 31; **72**, 31; **73**, 32; **74**, 37; **75**, 41; **76**, 94; **77**, 99; **78**, 113; **79**, 152; **80**, 203; **81**, 273; **82**, 269; **83**, 277; **84**, 277; **85**, 299; **86**, 294; **87**, 260; **88**, 236; **89**, 275, 287; **90**, 248; **91**, 318; **92**, 304; **93**, 345; **94**, 316; **95**, 354; **96**, 309; **97**, 393, 408; **98**, 385; **99**, 456; **1900**, 522.

ENGINEERS IN CHARGE:

Maj. J. B. Wheeler, 1866–70; **70**, 32. Report, **67**, 32.

Capt. J. W. Cuyler, 1870, temporarily in charge, **70**, 32, 33.

Maj. D. C. Houston, 1870–75. Reports, **71**, 109; **72**, 114; **73**, 196; **74**, 138.

Maj. H. M. Robert, 1875–82. Reports, **75**, 192; **76**, ii, 334; **77**, 852; **78**, 1141; **79**, 1484; **80**, 1903; **81**, 2058; **82**, 2125.

Maj. J. W. Barlow, 1883. **83**, 1629.

Capt. F. A. Hinman, 1883. Report, **83**, 1640.

Lt. Col. J. W. Barlow, 1884–86. Reports, **84**, 1835; **85**, 1978.

Capt. W. L. Marshall, 1886, **86**, 290.

Capt. C. E. L. B. Davis, 1886–91. Reports, **86**, 1652; **87**, 2004; (Maj.) **88**, 1837; **89**, 2044; **90**, 2328; **91**, 2527.

Maj. J. F. Gregory, 1892–94. Report, **92**, 2173; **93**, 2703; **94**, 2045.

Capt. C. F. Palfrey, 1895. Report, **95**, 2595.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2650, 2751; **98**, 2289.

Capt. J. G. Warren, 1899–. Reports, **99**, 2726; **1900**, 3650.

ASSISTANTS:

W. T. Casgrain. Report, **67**, 132.

Capt. J. W. Cuyler. Reports, **72**, 114; **73**, 196.

W. H. Hearding. Reports, **74**, 138; **75**, 192.

C. Crossman. Report, **84**, 1837.

**Expenditures.**

In repairs of south pier, **77**, 853.

**Operations.**[a]

**1871–72.** 1,150 l. f. of pile pier built on the south pier, **72**, 31, 115; **76**, ii, 336.

**1872–73.** 134 l. f. of pile pier built on the north and 197 f. on south side, and 133 f. of superstructure on the south pier; 585 f. of slab pier on north side built, **73**, 196, 197; **76**, ii, 337.

**1873–74.** 352 l. f. pile pier on north side and 720 f. on south side built; also 69 f. of superstructure on south pier, **74**, 138; **76**, ii, 337.

**1874–75.** 128 l. f. of pile pier on north side and 96 f. on south side built; 32 f. of superstructure built on south side; also 60,005 c. y. of dredging; repairs of piers, **75**, 192; **76**, ii, 337.

**1875–76.** 93,477 c. y. dredged from channel; repairs of piers, **76**, ii, 335.

**1876–77.** 40,584 c. y. dredged from channel, **77**, 852.

**1877–78.** 150 l. f. of crib pier on north side and 100 f. on south side built; 3,724 c. y. dredged from channel.

**1878–79.** 150 l. f. of crib pier built on the north side; also 100 f. of superstructure built on south and 150 f. on north pier; 1,588 c. y. dredged from channel, **79**, 152, 1484.

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[a] History of operations, **76**, ii, 335. Channel is 125 f. wide, 14 f. deep, and 2,800 f. long, **76**, ii, 337. List of material used and work done, with average cost of cribs, **78**, 1142; **79**, 1485.

## MENOMINEE HARBOR, MICH. AND WIS.—Continued.

**1879–80.** Six cribs sunk in extension of the north pier and superstructure built over 3 cribs previously sunk, **80**, 1903.

**1880–81.** Four cribs placed in extension of south pier, partial superstructure built over 6 cribs on north pier, and 2,500 c. y. dredged from channel, **81**, 2059.

**1881–82.** Six crib substructures placed in extension of south pier; superstructure built over 4 cribs, **82**, 2125.

**1882–83.** 3,950 c. y. dredged from channel, **83**, 1640.

**1883–84.** South pier extended 200 l. f. and partial superstructure built over 300 f. of same; north pier extended 50 l. f. and outer crib replaced, **84**, 1835.

**1884–85.** Superstructure completed over 350 f. of north pier and over 700 f. of south pier, **85**, 1978.

**1886–87.** 37,895 c. y. dredged, **87**, 2005.

**1889–90.** 610 l. f. of north pier rebuilt above the water line, and 1,105 c. y. dredged by hired labor, **90**, 2329.

**1890–91.** 14,170 c. y. dredged, **91**, 2527.

**1891–92.** Channel excavation completed, **92**, 2174.

**1894–95.** 1,309 l. f. south pier repaired, **95**, 2595, 2596.

**1895–96.** 13,650 c. y. dredged, **96**, 2460.

**1896–97.** 300 l. f. superstructure of north pier and 100 l. f. south pier rebuilt; opening between pile and crib piers closed; minor repairs made, **97**, 2650.

**1897–98.** 2,374 c. y. dredged, and repairs to piers in progress, **98**, 2290.

**1898–99.** Minor repairs to south pier, **99**, 2726.

**1899–1900.** Minor repairs to south pier; about 1,000 c. y. dredged, **1900**, 3650.

**Physical characteristics.**

General characteristics of Menominee River and Harbor, **67**, 132; **76**, ii, 335, 338; **97**, 2752.

Depth of water in river mouth previous to improvement, **76**, ii, 335, 336.

Bottom hard, compact sand, **72**, 115; **76**, ii, 336; **73**, 197.

Effect of south pier on river current, **72**, 115.

In 1895 there was a tendency to the formation of shoals in the harbor, **96**, 2460.

The harbor situated at the mouth of the river of the same name on the western shore of Green Bay, Lake Michigan, **97**, 2752.

**Plans.** (See *Projects.*)

By W. T. Casgrain, under direction of Maj. Wheeler, to open a channel across the neck of land between Green Bay and the Menominee River, and to construct two parallel piers in a direction due east; north pier 1,375 l. f. and south pier 1,275 l. f.; dredging in channel and in an inside basin to a depth of 12 f.; estimate, $252,571, **67**, 27, 134, 135.

In 1884 Lt. Col. Barlow, extension of the piers to the 18-f. curve in the lake, dredging between the piers, and extensive repairs to existing superstructure, increasing the estimate to $300,000, **84**, 1835, 1836.

**Private (private and corporate) work.**

The "gap" (**72**, 115) closed by pile work, **73**, 197; **76**, ii, 337.

Interior dredging and docking by the mill owners in 1874–76–77, **75**, 192; **76**, ii, 335; **77**, 852.

Improper use of piers by lumber companies, **84**, 1836, 1837; **85**, 300, 1879, 1880; **86**, 1652.

**Projects.** (See *Plans.*)

By Maj. Houston, 1871, two parallel pile piers at the mouth of the river, 400 f. apart, extending to the 15-f. curve in Green Bay, **71**, 109; **72**, 115; **76**, ii, 336.

To extend the piers to the 16-f. curve in the bay, 1874, and to dredge a channel 14 f. deep from mouth of river to the crossing of the ferry above; estimate, $212,000; **74**, 139; **79**, 1484; **84**, 1835; **86**, 1652.

In 1896 Capt. Zinn estimated it would cost about $19,000 to improve the harbor by dredging, **97**, 2754.

Consolidation of this work with that of the river recommended, 1899, **99**, 2726.

**Surveys.**

Under direction of Maj. Wheeler, 1867, **67**, 27, 132; **76**, ii, 336.

Examination under direction of Maj. Houston, 1871, **71**, 109; **76**, ii, 336.

Resurvey of channel, **78**, 113, 1142.

Of harbor and vicinity, 1881, **81**, 2059.

Ordered by act of Aug. 11, 1888; made, 1889, under direction of Maj. Davis, **89**, 2045.

Survey with a view to obtaining a channel 20 f. deep ordered by act of June 3, 1896, made in that year by Capt. Zinn, (see *Projects*), **97**, 2751.

Minor surveys, **1900**, 3650.

MAPS:

Of harbor, **76**, ii, 334

**81**, 2060.

## MENOMINEE RIVER, WIS.

**Appropriations.**

1890, $54,000, **90**, 2329.
1892, 20,500, **92**, 2176.
1894, 6,000, **95**, 2600.
1896, 15,000, **96**, 2464.
1899, 18,920, **99**, 2730.

Total, 114,420

**Commerce.**

Important, **1900**, 3744.

**Contracts.**

**1890.** Truman & Cooper, dredging, 10⅜ cents and 11⅜ cents per c. y., **91**, 2530.

**1896.** W. A. Starke, dredging clay, 9 cents per c. y.; bowlders and hard pan, 25 cents per c. y. ($7,996), **97**, 2653.

**1899.** E. J. Pryor, dredging, 9 cents per c. y., $15,480, **99**, 2730.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **90**, 259; **91**, 318; **92**, 304; **93**, 346; **94**, 316; **95**, 354; **96**, 310; **97**, 393; **98**, 385; **99**, 457, 474; **1900**, 522, 538.

ENGINEERS IN CHARGE:

Maj. C. E. L. B. Davis, 1889–92. Reports, **90**, 2394; **91**, 2528.

Maj. J. F. Gregory, 1892–94. Reports, **92**, 2175; **93**, 2706; **94**, 2047.

Capt. C. F. Palfrey, 1895. Report, **95**, 2599.

Capt. G. A. Zinn, 1896–98. Reports, **96**, 2463; **97**, 2652; **98**, 2291.

Capt. J. G. Warren, 1899–. Reports, **99**, 2728; **1900**, 3653, 3739.

ASSISTANT. L. M. Mann. Report, **90**, 2396.

**Operations.**

**1890–91.** 26,058 c. y. dredged, **91**, 2529.

**1891–92.** 126,047 c. y. dredged, **92**, 2176.

**1892–93.** 83,165 c. y. dredged, **93**, 2707.

**1893–94.** 79,330 c. y. dredged and repairs made to dredging plant, **94**, 2048.

**1894–95.** 19,530 c. y. dredged and dredging plant repaired, **95**, 2600.

**1895–96.** 6,728 c. y. dredged, **96**, 2464.

**1896–97.** 60,837 c. y. dredged, **97**, 2652.

**1897–98.** 58,583 c. y. dredged, **98**, 2291.

**1898–99.** 19,160 c. y. dredged, **99**, 2729.

**1899–1900.** 163,433 c. y. dredged, **1900**, 3653.

**Physical characteristics.**

Tendency to the formation of shoals, **96**, 2464. The materials brought down the stream by freshets make periodical dredging necessary, **98**, 2291.

Annual shoaling, **99**, 2729; **1900**, 3653.

Description of. The river forms the boundary line between the States of Michigan and Wisconsin, emptying into Green Bay, about 50 miles northeasterly from the city of Green Bay. Menominee, Mich., and Marinette, Wis., are at the river mouth. **1900**, 3742.

**Projects.**

By Maj. Davis, 1889, channel 16 f. deep and 200 f. wide, Green Bay to Ludington & Co.'s mill, 2 miles; estimate, $109,609, **90**, 2396; **92**, 2528. Width of channel reduced to 100 f. for a distance of 2,600 f., reducing the estimate to $74,500, **92**, 2530.

In 1892, after expenditure of $74,500, it was estimated that $10,000 would be required for maintenance of improved channel, **92**, 2176.

By Capt. Zinn, 1896, to modify project to provide for a turning basin at the western end of the channel, and also to extend the channel 425 f., with a width of 75 f. and depth of 17 f., **96**, 2463.

By Capt. Zinn, 1896, for dredging a 20-f. channel in the river (harbor?); estimate, $18,920, **97**, 2751; **99**, 2728.

Consolidation of this work with that for the harbor recommended, **99**, 2729.

Capt. Warren estimated, 1899, it would cost $60,000 and $7,500 annually for an 18-f. channel, but improvement would have to be inside shore line, which might establish a precedent for like improvement at other places, **1900**, 3744.

**Surveys.**

Ordered by act of Aug. 11, 1888, made, 1889, under direction of Maj. Davis, **90**, 2395.

Miscellaneous surveys, **93**, 2707; **94**; 2048.

Examination and survey from line of the second bridge, project of 1896, up to the west line of Wells street, for an 18-f. channel, ordered by act of Mar. 3, 1899, made, 1899, by Capt Warren (report favorable) (see *Projects*), **1900**, 3739.

MAPS. **93**, 2706.

## MERAMAC RIVER, MO.

**Commerce.** (See *Physical characteristics.*)

**Engineers.**
CHIEF OF ENGINEERS Reports, **80**, 161; **81**, 223.
ENGINEER IN CHARGE. Capt. O. H. Ernst. Report, **81**, 1596.

**Physical characteristics.**
Meramac not navigable and not susceptible to such improvement as would adapt it to the commerce of the surrounding country, **81**, 1597.

**Survey.**
Ordered by act of June 14, 1880, made, 1880, under direction of Capt. Ernst (see *Physical characteristics*), **81**, 1596.

## MERCED RIVER, CAL.

**Commerce.**
Description of; small, **93**, 3298.

**Engineers.**
CHIEF OF ENGINEERS. Report, **93**, 431.
ENGINEER IN CHARGE. Maj. W. H. Heuer, 1893. Report, **93**, 3297.

**Physical characteristics.**
Description of; crooked branch of the San Joaquin River, about 60 miles long, heading in the Yosemite Valley and emptying into the San Joaquin at Hills Ferry, **93**, 3297.

**Survey.**
Examination ordered by act of July 13, 1892, made in that year by Maj. Heuer, (report unfavorable) **93**, 3297.

## MERMENTAU (MERMENTON) RIVER AND TRIBUTARIES, LA.

**Appropriations.**
1892, $7,500.00, **93**, 1829.
1894, 5,000.00, **95**, 1769.
1896, 5,000.00, **96**, 1508.
1899, 6,115.25, **99**, 1851.

Total, 23,615.25

**Commerce.**
May be important, **91**, 1862.
From Jan. 1 to Dec. 31, 1899, commerce amounted to 2,866 tons, **1900**, 2264.

**Contracts.**
**1892.** Harvey & Erlinger, furnishing steamboat for snagging, $98 per day, **93**, 1829.
**1897.** C. Clarke, operation of U. S. dredge, $32 per day; brush dam construction, $1.03 per l. f. ($7,969), **98**, 1479.
**1899.** C. Clarke & Co., furnishing dredge boat and crew, $122 per day of 16 hours, **1900**, 2265.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **91**, 230; **93**, 246; **94**, 227; **95**, 254; **96**, 221; **97**, 285; **98**, 275; **99**, 329; **1900**, 374.
ENGINEERS IN CHARGE:
Capt. W. L. Fisk, 1891. Report, **91**, 1858.
Maj. J. B. Quinn, 1891-99. Reports, **91**, 1862; **93**, 1828; **94**, 1372; **95**, 1768; **96**, 1507; **97**, 1767; **98**, 1478; **99**, 1851.
Maj. H. M. Adams, 1900. Report, **1900**, 2264.

ASSISTANT. P. H. Thompson. Reports, **91**, 1859, 1863.

**Operations.**
**1892-93.** Over 500 obstructions removed, **93**, 1828.
**1896-97.** Nearly 27,000 c. y. dredged; upper dam, 2,500 f. long and 5 f. wide, and lower dam, 3,000 f. long, completed, **97**, 1478.
**1899-1900.** 39,484 c. y. dredged, **1900**, 2264.

**Physical characteristics.**
Description of, including its five tributaries (bayous), stream is 254 miles long, **91**, 1859.

**Plans.** (See *Projects.*)
By Maj. Quinn, 1891, clearing obstructions, Viterboville to the mouth, and building of a brush dam at Lower Mud Lake, estimate, $23,615. Jetties at the mouth to give deep water over the bar, estimate, $781,210, **91**, 1863.

**Projects.** (See *Plans.*)
By Maj. Quinn, 1897, for applying available money to building brush dams in Mud Lake to help secure channel 50 f. wide and 6 f. deep, and to dredging to secure immediate results, **97**, 1767.
By Maj. Adams, 1899, for redredging channel, **1900**, 2,264.

**Surveys.**
Examination made under direction of Capt. Fisk, 1890 (report favorable to survey), **91**, 1858.
Survey made, 1891, under direction of Maj. Quinn, **91**, 1862.
Minor surveys made, 1899, **99**, 1852.

### MERMONTON RIVER. (See *Mermentau River, La.*)

### MERRIMAC RIVER, MASS.[a] (See *Newburyport Harbor, Ms.*)

**Appropriations.**

| | | |
|---|---|---|
| 1828, | $32,100.00, | act May 23. |
| 1830, | 3,506.72, | act Apr. 23. |
| 1831, | 16,000.00, | act Mar. 2. |
| 1833, | 4,900.00, | act Mar. 2. |
| 1834, | 3,860.00, | act June 28. |
| 1842, | 8,000.00, | act (relief) June 4. |
| 1870, | 25,000.00, | **71**, 93. |
| 1871, | 25,000.00, | **71**, 93. |
| 1872, | 25,000.00, | **72**, 92. |
| 1873, | 25,000.00, | **73**, 101. |
| 1874, | 10,000.00, | **74**, 111. |
| 1875, | 12,000.00, | **75**, 116. |
| 1878, | 10,000.00, | **78**, 41. |
| 1879, | 5,000.00, | **79**, 49. |
| 1880, | 12,000.00, | **80**, 345. |
| 1881, | 9,000.00, | **81**, 514. |
| 1882, | 9,000.00, | **82**, 512. |
| 1884, | 3,500.00, | **84**, 501. |
| 1890, | 10,000.00, | **90**, 485. |
| 1892, | 1,500.00, | **92**, 555. |
| 1896, | 5,000.00, | **96**, 591. |
| 1899, | 40,000.00, | **99**, 1061. |
| Total, | 295,366.72 | |

**Commerce.**

Important. **70**, 472; **73**, 1112, 1113; **79**, 267.

Newburyport a harbor of refuge, **70**, 472.

Description of, **96**, 616; **97**, 865; **98**, 885.

**Contracts.**

**1870.** G. W. Townsend, removal of obstructions, **70**, 467. A. Baschké, removal of obstructions, $25 per c. y., **70**, 467; **71**, 869.

**1871.** W. S. Fretch, dredging, $10 per c. y., **71**, 868.

**1873.** A. R. Wright, dredging, $4.95 per c. y., **73**, 1082. A. R. Wright, dredging, $4.50 per c. y., **73**, 1082.

**1875.** Curtis, Forbes & Co., dredging, 35 cents per c. y., **75**, ii, 401.

**1878.** T. A. Sylvester, removal of rock, $28 per c. y., **79**, 264.

**1880.** J. Andrews, removal of Gangway Rock, $30 per c. y., **81**, 515.

**1881.** G. W. Townsend, removal of Gangway Rock, $27.50 per c. y., **81**, 515. Trumbull & Cheney, removal of rock, $44 per c. y., **81**, 575. Contract abandoned after partial completion, **83**, 440.

**1882.** Hamilton & Floyd, removal of South Badger Ledge, $110 per c. y., **83**, 441. G. W. Townsend, removal of North Rocks, $35 per c. y., **83**, 441.

**1884.** J. McDermott, dredging, Rock's Bridge, $2.18 per c. y., **85**, 500.

**1892.** Sturgis & Andrews, ledge removal at $13.85 per c. y., p. m. ($4,847.50), **93**, 744.

**1896.** Eastern Dredging Co., dredging 1,250 c. y., $4; removal of bowlders over 6 tons $10, **97**, 829.

**1899.** A. E. Smith, dredging 72,727 c. y., 49½ cents s. m.; removal of bowlders over 3 tons in weight, $10 each (annulled), **1900**, 1156.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **69**, 60; **70**, 78; **71**, 92; **72**, 91; **73**, 101, 106; **74**, 110; **75**, 116; **76**, 42; **77**, 36; **78**, 41; **79**, 48; **80**, 68; **81**, 72, 77; **82**, 72, 77; **83**, 67; **84**, 74; **85**, 61; **86**, 61; **87**, 23; **88**, 23; **89**, 33; **90**, 27; **91**, 34; **92**, 40; **93**, 39; **94**, 37; **95**, 40; **96**, 42, 54; **97**, 46, 64; **98**, 54, 69; **99**, 63; **1900**, 70.

ENGINEERS IN CHARGE:

Lt. Col. J. G. Foster, 1869–71. Reports, **69**, 421, 437; **70**, 467, 469, 471, 473; **71**, 867.

Lt. Col. G. Thom, 1871–83. Reports, **71**, 866; **72**, 940, 961; **73**, 1081, 1112, 1114; **74**, ii, 310; **75**, ii, 399; **76**, 165; **77**, 169; **78**, 205; **79**, 264; (Col.), **80**, 343; **81**, 511; **82**, 510, 532.

Maj. C. W. Raymond, 1883–86. Reports, **83**, 439; **84**, 500; **85**, 499.

Lt. Col. G. L. Gillespie, 1886–89. Reports, **86**, 560; **87**, 493; **88**, 436.

Lt. Col. S. M. Mansfield, 1889–98. Reports, **89**, 556; **90**, 484; **91**, 628; **92**, 554; **93**, 742; **94**, 532, 430; **95**, 600; **96**, 590, 616; **97**, 827, 865; **98**, 850, 884.

Col. C. R. Suter, 1899. Report, **99**, 1058–1060.

Maj. W. L. Fisk, 1900. Report, **1900**, 1155.

ASSISTANTS:

Capt. G. L. Gillespie. Report, **69**, 438.
H. Mitchell. Report, **70**, 474.
D. Koppman, **70**, 473.
Lt. J. B. Quinn. Report, **73**, 1112.
G. P. Low. Report, **72**, 962.
S. Haagensen. Reports, **82**, 535–544; **83**, 441.
T. T. H. Harwood. Reports, **96**, 618; **98**, 885.

**Obstructions.**

Bridge between Haverhill and Bradford, **94**, 430.

**Operations.**

**1870–71.** Removal of schooner *Globe*, **71**, 867. Removal of main (south) Gangway Rock, 600 tons rock, **71**, 867. Removal of part of North Gangway Rock to 9.5 f. in depth, **72**, 91, 940. Channel at Lower Falls, 475 c. y. dredged, **72**, 92, 940; **74**, 110; ii, 310.

**1871–72.** Channel at Lower Falls, 2,731 c. y. dredged, **72**, 92, 940; **74**, 110, ii, 310.

**1872–73.** Channel at Upper Falls, 3,755 c. y. dredged, **74**, 111; ii, 310.

**1874–75.** Completion of work above Haverhill, **75**, 116. Channel at Upper Falls, 3,146.2 c. y. dredged, **75**, ii, 400, 401. Channel at Lower Falls, 3,570.2 c.

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[a] Survey—Report 1826, estimate, $32,080.27. (H. Doc. No. 482, 55th Cong., 2d sess.)

## MERRIMAC RIVER, MASS.—Continued.

y. dredged, **75**, ii, 400, 401. Ledge and Little Currier Rock, 60 c. y. rock removed, **75**, ii, 400, 401.

**1875–76.** Rocks removed from Currier Shoal and Rockbridge, including Petty Rock, **76**, 166.

**1876–77.** Channel 100 by 12 f. through shoals, **77**, 170. Channel 75 by 12 f. to Silsby's Island, **77**, 170.

**1877–78.** Removal of bowlders from Silsby's Island, 80 tons rock, **78**, 206.

**1878–79.** Removal from North Gangway Rock, 305 c. y. rock, **79**, 48, 264.

**1879–80.** Improvement of channel at and below the upper and lower falls, **80**, 344.

**1880–81.** 124¼ c. y. rock removed from Gangway Rock, North Rocks, and from channel at Lower Falls; also removal of sunken piers and wrecks from Newburyport Harbor and deepening the channel by dredging at the Lower Falls Rock's Bridge, **81**, 512.

**1881–82.** Completion of the removal of South Gangway Rock to 9 f. depth and of South Badger Ledge and North Spur Rocks in part to depth of 10 f., **82**, 511.

**1882–83.** Breaking up and removal of South Badger Ledge and partial removal of North Rock, **83**, 440.

**1883–84.** Removal of North Rock to a depth of 9 f., **84**, 500.

**1884–85.** 1,056 c. y. bowlders, gravel, and clay dredged from channel at Rock's Bridge, **85**, 500.

**1892–93.** 201 c. y. rock removed, **93**, 743.

**1893–94.** 149 c. y. rock removed; project completed, **94**, 532.

**1896–97.** 855 c. y. rock removed, **97**, 828.

**1897–98.** 205 t. bowlders removed, **98**, 850.

**Physical characteristics.**

Description of obstructions, **69**, 438; **70**, 473, 474; **73**, 1113.

Of river, **70**, 474; **72**, 961, 962; **73**, 1113; **88**, 436; **96**, 616; **97**, 865; **98**, 885.

Description of, Lawrence to Manchester, **82**, 532.

**Plans.** (See *Projects.*)

By H. Mitchell, 1870, moving barges over the rapids, **70**, 476.

By Lt. Col. Thom, 1871, slack-water navigation, Upper Falls, dam 900 f. by 9 f.; estimate, $130,000, **71**, 869; **72**, 962.

By Col. Thom, 1881, improved channel, head of Mitchells Falls at Lawrence, 21½ miles above the mouth of the river, to Manchester, N. H., 70 miles above the mouth, by rock removal and dredging, with locks and canal walls on the section of river between Nashua and Manchester, N. H. Estimate, $548,000, exclusive of the cost of new canals and locks at Lawrence and Lowell or the cost of adapting the present ones to the purpose of navigation. **82**, 533, 534, 539, 541.

**Private and corporate work.**

Survey, by H. Mitchell, for the Pentucket Navigation Co., **70**, 474.

**Projects.** (See *Plans.*)

Between 1828 and 1834, inclusive, $60,366.72 was appropriated for the removal of a sand bar and the construction of a breakwater at the river's mouth.

The original project, 1869, proposed the removal of obstructions from the upper and lower falls of Gangway Rock, the Boilers, and a wreck near the mouth: estimate, $69,025, **69**, 421; **70**, 469, 473; **76**, 165; **86**, 61.

In 1874 the project was extended to include the removal of rocks at Deer Island and at Rocks Bridge and Little Currier Shoal, to give channel depths at ordinary high water as follows: From mouth to Deer Island Bridge, 16½ f.; thence to Haverhill Bridge, 12 f.; thence to foot of Mitchells Falls, 10 f.; thence to head of Upper Falls, 4½ f.; estimate, including project of 1869, $147,000, **76**, 165; **86**, 61; **87**, 494. Project completed in 1884, with the exception of the removal of the "Boilers," under an aggregate appropriation of $167,000, when it was estimated that $26,000 additional would be required for the further improvement of the river between Plumb Island Light and Lawrence, **82**, 534, 541; **84**, 501; **86**, 561; **87**, 494.

From 1883–86 additional improvements were recommended by Maj. Raymond for the river below Mitchells Falls, including removal of the "Boilers" and sunken rocks at the Falls, estimate, $11,500, **90**, 485.

In 1892 $11,000 was estimated as required for the extension of the improvement to Lawrence, 5 miles above the Falls, **92**, 555.

Congress, 1896, appropriated $5,000 for removing some rocks below Rock Bridge, **96**, 590.

Lt. Col. Mansfield, 1896, estimated it would cost $1,496,851.07 to obtain 12-f. channel from mouth to Haverhill, **96**, 617; and in 1897 that it would cost $171,442.70 for a 7-f. channel, **97**, 865.

**Surveys.**

Survey by Capt. Gillespie, **69**, 60, 421, 437, 438, 473, 474.

Survey by G. P. Low, 1871, from Hazeltine Rapids to Lawrence, **72**, 940, 961, 962; **73**, 106.

Survey by Lt. Quinn, 1872, **73**, 1112.

From Lawrence to Manchester, ordered by act of March 3, 1881, **81**, 77; made under direction of Col. Thom, 1881, **82**, 532. At Rocks Bridge, made, 1883, **83**, 441.

## MERRIMAC RIVER, MASS.—Continued.

Survey with a view to obtaining a depth up to Haverhill equal to depth over bar at river mouth ordered by act of Aug. 17, 1894, made in 1896, under direction of Lt. Col. Mansfield (see *Projects*), **96**, 616.

Survey of the same course ordered by act of June 3, 1896, made, 1897, by Lt. Col. Mansfield (see *Projects*), **97**, 865.

Survey from Lowell to old N. H. State line, ordered by act of June 3, 1896, made, 1898, under direction of Lt. Col. Mansfield (report unfavorable), **98**, 885.

MAPS, **89**, 556.

## METO. (See *Metre Bayou, Ark.*)

## METRE BAYOU (Meto), ARK.

**Commerce.**

Unimportant, **84**, 1408.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 232.

ENGINEER IN CHARGE. Capt. T. H Handbury. Report, **84**, 1408.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Handbury (report unfavorable), **84**, 1408.

## MEXICO BAY, N. Y. (See *Sandy Creek, N. Y.; Salmon River N. Y.*)

**Commerce.**

In 1892 Capt. Kingman thought that the value of a harbor of refuge at this place was measured by the value of the entire commerce on Lake Ontario, but the Division Engineer and the Chief of Engineers did not consider the work a worthy one for the Government to undertake, **93**, 3169, 3173, 3174.

**Engineers.**

CHIEF OF ENGINEERS. Report, **93**, 3169.

ENGINEER IN CHARGE. Capt. D. C. Kingman, 1893. Report, **93**, 3169.

**Physical characteristics.**

Description of: The bay comprises that part of Lake Ontario lying east of a straight line joining Stony Point with Nine Mile Point east of Oswego. **93**, 3169.

**Surveys.**

Examination for a harbor of refuge ordered by act of July 13, 1892, made by Capt. Kingman, 1892 (see *Commerce*), **93**, 3169.

## MIAMI AND ERIE CANAL, OHIO. (See *Erie Lake and Ohio River Canal.*)

## MIANUS RIVER, CONN. (See *Coscob Harbor.*)

## MICHIGAN. (See *Illinois and Michigan Canal; Lake Michigan.*)

## MICHIGAN CITY HARBOR, IND.[a]

**Appropriations.**

| | | |
|---|---|---|
| 1836, | $20,000.00 | **66**, iii, 35. |
| 1337, | 30,000.00 | |
| 1888, | 60,733.59 | |
| 1844, | 25,000.00 | |
| 1852, | 20,000.00 | |
| 1855, | 470.33 | (claim), act Mar. 2. |
| 1866,[b] | 75,000.00 | |
| 1868, | 25,000.00 | (allotment), **68**, 24, **69**, 29. |
| 1869, | 31,185.00 | (allotment), **69**, 22, 29. |
| Total, | 287,388.92 | |
| OUTER HARBOR: | | |
| 1870, | $25,000.00, | **70**, 38. |
| 1871, | 15,000.00, | **71**, 36. |
| 1872, | 50,000.00, | **72**, 34. |
| 1873, | 50,000.00, | **73**, 35. |
| 1874, | 50,000.00, | **74**, 41. |
| 1875, | 50,000.00, | **75**, 46. |
| 1876, | 35,000.00, | **76**, 99. |
| 1878, | 2,500.00, | (allotment), **78**, 119. |
| 1878, | 50,000.00, | **78**, 119. |
| 1879, | 40,000.00, | **79**, 160. |
| 1880, | 40,000.00, | **80**, 2005. |
| 1881, | 20,000.00, | **81**, 2185. |
| 1882, | 60,000.00, | **83**, 1801. |
| 1884, | 40,000.00, | **85**, 2089. |
| 1886, | 54,375.00, | **86**, 1775. |
| 1888, | 90,000.00, | **88**, 1920. |
| 1890, | 50,000.00, | **90**, 2665. |
| 1892, | 30,000.00, | **92**, 2367. |
| 1894, | 20,000.00, | **95**, 2781. |
| 1896, | 70,000.00, | **96**, 2677. |
| 1900, | 195,000.00, | **1900**, 3876. |
| Total, | 1,036,875.00 | |

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[a] Survey—Report, Jan. 19, 1835. (H. Doc. No. 482, 55th Cong., 2d sess.)

[b] Appropriation of 1866 was to be available when it was shown that $100,000 had been expended by Michigan City Harbor Co., 67, 23, 96.

## MICHIGAN CITY HARBOR, IND.—Continued.

**Appropriations**—Continued.

INNER HARBOR:

1878, $25,000.00, **78**, 119, 1189.
1880, 15,000.00, **80**, 2006.
1881, 25,000.00, **81**, 2195.
1882, 20,000.00, **83**, 1802.
1884, 10,000.00, **85**, 2090.
1886, 1,875.00, **86**, 1776.
1888, 5,000.00, **88**, 1921.
1890, 7,500.00, **90**, 2666.
1892, 15,000.00, **92**, 2368.
1895, 10,000.00, **95**, 2777.
1896, 10,000.00, **96**, 2675.
1899, 7,500.00, **99**, 2897.

Total, 151,875.00

Total, outer and inner harbor, $1,476,138.92.

**Commerce.**

Important, **67**, 93, 98; **68**, 115; **70**, 97, 108; **76**, ii, 445, 451; **77**, 898; **79**, 1589.

Commercial advantages of Michigan City, **70**, 108.

Vessels wrecked at or near Michigan City, **82**, 2269.

Increase in commercial receipts, **82**, 2272.

In 1895 the importance of the harbor as a harbor of refuge was well recognized, **95**, 2780.

Up to 1898 the annual benefits to commerce by the large expenditures on this work important, **98**, 2491.

**Contracts.**

**1867.** F. A. Slater, timber and framing, **67**, 23; contract annulled, **68**, 112. Chapin & Wells, bolts and spikes, **67**, 23. J. D. Dolan, stone and brush, **67**, 23.

**1868.** J. D. Dolan, timber and framing, **68**, 112.

**1872.** Fox & Howard, pier extension, **73**, 216.

**1873.** J. H. Ledlie, pier extension, **73**, 216.

**1874.** Culbert & Hopkins, building pile breakwater, **75**, 234; work transferred to eastern pier of outer basin, **75**, 237.

**1875.** Culbert & Hopkins, building crib breakwater, **75**, 235; **76**, ii, 447.

**1879.** U. Culbert & Co., dredging, **79**, 1594. A. S. Packard, timber, **80**, 2005.

**1881.** N. Culbert, dredging, 18 cents per c. y., **81**, 2193.

**1883.** A. H. Petrie & Co., timber, **83**, 1799. Haskell & Barber Car Co, iron, **83**, 1799.

**1886.** J. M. Allmendinger, oak timber; A. H. Petrie, pier timber and plank; S. D. Kimbark, iron; Leathern & Smith, piles, and Chicago and Lemont Stone Co., stone, **87**, 2205.

**1889.** H. B. Herr & Co., outer harbor breakwater construction, $69,239.17, **89**, 2200.

**1890.** H. B. Herr & Co., white pine timber, $17.90 per M f., B. M., **90**, 2666. Parkhurst & Wilkinson, drift bolts and spikes, 2¼ to 2¾ cents per pound; E. G. Crosby, timber, $18.50 per M f., B. M.; J. S. Hopper & Sons, plank, $13 per M f., B. M., **91**, 2708.

**1892.** Wisconsin Dredge & Dock Co., pier construction, $24,669, **93**, 2863.

**1897.** W. A. Starke, dredging, 13 cents per c. y.; transfer of plant, $2 per mile, **97**, 2897.

**1898.** W. A. Starke, dredging, 14 cents per c. y., **98**, 2493.

**1899.** Green's Dredging Co., 15 cents per c. y., **99**, 2900.

**1900.** Stebbings & Wenzell, breakwater constructing (dredging, piles, timber, ironwork, stone), $267,029.43, **1900**, 3877. Green's Dredging Co., dredging inner harbor, 16¼ cents per c. y., **1900**, 3878.

**Defense.**

Plan for roadstead, for armed vessels, and for general commerce of the lakes, S. Doc. 42, 35th Cong., 1st sess., p. 175.

**Documents.**

S. Doc. 16, 34th Cong., 3d sess. Report of Maj. Graham, 1856, S. Doc. 42, 35th Cong., 1st sess., p. 74.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **66**, ii, 41, iii, 35; **67**, 23, 26; **68**, 32; **69**, 22, 28; **70**, 37; **71**, 36; **72**, 34; **73**, 35; **74**, 41; **75**, 46; **76**, 99; **77**, 104; **78**, 118; **79**, 160; **80**, 212; **81**, 287; **82**, 282, 2262, 2270; **83**, 290; **84**, 292; **85**, 322; **86**, 316; **87**, 284; **88**, 258; **89**, 304; **90**, 273; **91**, 344; **92**, 330; **93**, 366; **94**, 337; **95**, 376; **96**, 332; **97**, 421; **98**, 409; **99**, 486; **1900**, 550.

BOARDS OF ENGINEERS.

Mentioned, S. Doc. 42, 35th Cong., 1st sess., p. 74.

Convened at Milwaukee, Jan. 19, 1870. Decided outer harbor not justified by local commerce, but that harbor of refuge was necessary, and this best supplied by construction of outer harbor. (See *Projects.*) Report, **70**, 124. (Col. Macomb, Lt. Col. Raynolds, and Majs. Wheeler, Weitzel, and McFarland.)

Convened at Chicago Jan. 5, 1875. Recommended adoption of plan for construction of breakwater by crib work in preference to pile work. Report, **75**, 238. (Majs. Weitzel, Houston, and Gillespie.)

Convened July 24, 1878. Recommended adoption of plan (see *Projects*) for the construction of a crib breakwater on bearing piles, strengthened on the lake side by vertical timbers; also recommended extension of east pier of the outer harbor. Report, **79**, 1588. (Majs. Houston, Robert, Smith, and Mansfield, and Capt. Lydecker.)

## MICHIGAN CITY HARBOR, IND.—Continued.

Convened at Michigan City July 6, 1880, by S.O. No. 83, C. of E., to report upon improvement of Michigan City Harbor. Report, **81**, 2187. (Majs. Houston, Robert, Smith, and Lydecker.)

Convened at Milwaukee, Wis., May 22, 1882, by S. O. No. 19, C. of E., to report upon projects by Maj. Smith, for breakwater and completion of outer harbor. Report, **82**, 2264. (Majs. Houston, Robert, Smith, and Lydecker.)

Convened at Chicago, Ill., on Mar. 4, 1897, by S. O. No. 8, to examine and report on a proposed project for the improvement of the harbor. Report, **97**, 2903. (Lt. Col. Lydecker, Maj. Marshall, Capt. Townsend.)

ENGINEERS IN CHARGE:

Lt. Col. J. D. Graham, 1856–57. Report, S. Doc. 42, 35th Cong., 1st sess., p. 74.

Maj. J. B. Wheeler, 1866–70; **66**, ii, 41. Reports, **67**, 93, 96, 100; **68**, 111, 115; **70**, 107.

Capt. J. W. Cuyler, 1870; **70**, 33.

Maj. W. E. Merrill, 1870; **70**, 89; **76**, ii, 450.

Maj. D. C. Houston, 1870–74; **70**, 32. Reports, **70**, 97; **71**, 119; **72**, 130; **73**, 216; **74**, 160.

Maj. G. L. Gillespie, 1874–77. Reports, **75**, 234; **76**, ii, 444.

Capt. G. J. Lydecker, 1877–79. Reports, **77**, 896; **78**, 1187.

Maj. J. A. Smith, 1878–85. Reports, **79**, 1587; **80**, 2003; **81**, 2183, 2186, 2190; **82**, 2257, 2260, 2263, 2267; **83**, 1797; **84**, 1965.

Capt. D. W. Lockwood, 1885–87. Reports, **85** 2088; **86**, 1774; **87**, 2202.

Maj. S. M. Mansfield, 1888–89. Report, **88**, 1919.

Maj. W. Ludlow, 1889–93. Reports, **89**, 2197; **90**, 2662; **91**, 2706; **92**, 2365; **93**, 2858.

Lt. Col. G. J. Lydecker, 1893–96, 1898. Reports, **94**, 2188; **95**, 2776; **96**, 2674; **98**, 2489.

Capt. C. McD. Townsend, 1897. Report, **97**, 2895.

Capt. C. Harding, 1899–. Reports, **99**, 2895; **1900**, 3873.

ASSISTANTS:

Capt. A. Mackenzie. Report, **67**, 97.

Capt. D. P. Heap. Reports, **67**, 93, 96; **68**, 111; **70**, 107.

Lt. F. A. Hinman. Reports, **73**, 216; **74**, 160.

R. S. Littlefield, **77**, 897.

**Estimates**. (See *Plans* and *Projects*.)

By Capt. Heap, breakwater and dredging, $578,500 and $512,900, **70**, 110.

By Maj. Smith, dredging and filling piers, $69,175, **79**, 1590, 1592.

**Operations.**

Mention of former operations, **67**, 98.

**1866–67.** 9,235 c. y. dredged; 1,135 l. f. east and 995 l. f. west pier extension built (length previous to 1866), **67**, 96, 98.

**1867–68.** 38,684 c. y. dredged, **68**, 32, 114.

**1868–69.** 111,080 c. y. dredged; 96 l. f. east and 256 l. f. west pier extension built; 708 f. sheath piling, **69**, 28.

**1869–70.** Piers built to 12 f. depth; sheath piling completed, **70**; 37, 97.

**1870–71.** Some dredging, **71**, 36, 119.

**1871–72.** 70,000 c. y. dredged, **72**, 34, 130.

**1872–73.** 18,585 c. y. dredged; 1,226 l. f. pile work eastern breakwater built; 723 l. f. bridged, **73**, 216.

**1873–74.** Western pier extended to line of proposed breakwater; 503 f. bridged, **74**, 41, 160.

**1874–75.** 50 l. f. crib and 45 l. f. pile work built on outer breakwater, and 520 l. f. pile work built on eastern breakwater, **75**, 46, 234; **76**, ii, 444.

**1875–76.** 600 l. f. crib built on outer breakwater, and 296 l. f. pile work built on eastern breakwater (repairs), **76**, ii, 444.

**1876–77.** One course superstructure built over 12 cribs; repairs, **77**, 104, 896.

**1877–78.** Four courses superstructure laid; cribs displaced by gales; repairs, **78**, 118, 1187, 1188.

**1878–79.** 64,119 c. y. dredged; 50 l. f. crib built on outer breakwater; superstructure finished, 550 f., **79**, 160, 1588, 1591, 1593, 1594.

**1879–80.** *Outer harbor:* Six cribs sunk in extension of breakwater and 300 l. f. of superstructure built; also repairs to piers, **80**, 2003. *Inner harbor:* 77,287 c. y. dredged, **80**, 2006.

**1880–81.** *Outer harbor:* Breakwater extended 150 f. on pile foundation; 5,924 c. y. dredged, **81**, 2183. *Inner harbor:* 58,224 c. y. dredged by city, **81**, 2193.

**1881–82.** *Outer harbor:* Breakwater extended 200 l. f.; extensive repairs to piers; stone scows built and cribs framed, **82**, 2257, 2258, 2259. *Inner harbor:* 62,189 c. y. dredged, **82**, 2270.

**1882–83.** *Outer harbor:* 150 l. f. cribwork built; 6,504 c. y. dredged; repairs to plant, breakwater, and pier, **83**, 1798. *Inner harbor:* 111,590 c. y. dredged, **83**, 1802.

**1883–84.** *Outer harbor:* 100 l. f. crib work, with superstructure added to east breakwater; piers and breakwater repaired, **84**, 1965, 1966. *Inner harbor:* 116,465 c. y. dredged, **84**, 1969.

**1884–85.** *Outer harbor:* End wall of west harbor pier rebuilt; one crib sunk in extension of new breakwater pier; 18,370 c. y. dredged, **85**, 2088. *Inner harbor:* 21,890 c. y. dredged, **85**, 2089.

**1885–86.** *Outer harbor:* 50 l. f. crib work, with superstructure placed in extension of breakwater pier; break in south wall repaired; two new courses of

## MICHIGAN CITY HARBOR, IND.—Continued.

superstructure added to west pier; extensive repairs to plant, **86**, 1774. *Inner harbor:* 27,205 c. y. dredged, **86**, 1776.

**1886–87.** Repairs to west pier, **87**, 2202.

**1887–88.** *Outer harbor:* 542 l. f. of pile portion of west pier rebuilt, entire west pier filling replaced, and general repairs to breakwater. *Inner harbor:* 4,510 c. y. dredged, **88**, 1919, 1920.

**1888–89.** *Outer harbor:* Outer end of west pier decked over; "Breakwater Pier" completed by construction and placing of 150 l. f. of crib work. *Inner harbor:* 64,085 c. y. dredged, **89**, 2199, 2201.

**1889–90.** *Outer harbor:* 500 l. f. of new breakwater work built; repairs to prior breakwater construction. *Inner harbor:* 24,740 c. y. dredged, **90**, 2665, 2666.

**1890–91.** *Outer harbor:* Reconstruction of the 3 outer cribs of the breakwater pier completed; repairs to outer 535 feet of the west pile pier; leveling up of outer breakwater superstructure, **91**, 2706.

**1891–92.** *Outer harbor:* Repairs to breakwater; superstructure completed over the 500 f. of crib work in the outer breakwater, **92**, 2366. *Inner harbor:* Repairs to dredging plant; 84,893 c. y. dredged, **92**, 2368.

**1892–93.** Outer breakwater repaired, **93**, 2859; 61,940 c. y. dredged from inner harbor, and repairs made to Government dredging plant, **93**, 2861, 2862.

**1893–94.** *Inner harbor:* Repairs were made to west pile pier, and 27,231 c. y. dredged, **94**, 2188. *Outer harbor:* Extension of exterior breakwater in progress, **94**, 2190.

**1894–95.** *Inner harbor:* 25,582 c. y. dredged, **95**, 2776. *Outer harbor:* Extension of exterior breakwater in progress, and some repairs made, **95**, 2777, 2779.

**1895–96.** *Inner harbor:* 27,321 c. y. dredged, and piers repaired, **96**, 2674. *Outer harbor:* Extension of exterior breakwater completed, **96**, 2676; older portions of breakwater repaired, **96**, 2676.

**1896–97.** *Inner harbor:* Minor repairs to piers, and maintenance of plant, **97**, 2896. *Outer harbor:* Breakwater repaired, **97**, 2897.

**1897–98.** *Inner harbor:* 55,534 c. y. dredged, **98**, 2490.

**1898–99.** 18,771 c. y. dredged from inner harbor, and rapairs made to breakwaters of outer harbor, **99**, 2896.

**1899–1900.** 3,253 c. y. dredged, and west pier repaired at inner harbor; work in progress on breakwaters at outer harbor, **1900**, 3874.

**Physical characteristics.**

Character of lake bed, **67**, 93, 95; **75**, Record of rise and fall of Lake Michigan, **67**, 100.

Formation of bars, **71**, 119; **75**, 235; **79**, 1593.

Description of, **97**, 2900.

**Plans.** (See *Estimates* and *Projects.*)

By Capt. Heap, making two outer harbors or basins with breakwaters and dredging; first plan, 3,200 f. of pier work; second plan, 2,950 f., **70**, 109, 110.

By Maj. Smith, dredging and refilling cribs with stone, **79**, 1590, 1593.

By Maj. Smith, 1882, a modification in the construction of the remaining 166 inner f. of the eastern end of the breakwater and also the construction of an outer breakwater northwest of the existing harbor entrance, **82**, 2260–2264.

**Private (private, city, and corporate) work.**

$100,526.03 expended by Michigan City Harbor Co., pier construction, dredge, etc., **67**, 23, 93, 96, 100.

Channel protected by repairs put upon the old piers by citizens, **72**, 130.

Banks of channel of the inner harbor protected by revetment built by the direction of the city, **79**, 1593.

**Projects.** (See *Estimates* and *Plans.*)

Work at this harbor was commenced by the United States in 1836. Between this date and 1852 $156,203.92 was appropriated, including relief claims, applied to dredging, crib construction at the entrance of the harbor, and the commencement of a breakwater covering the entrance. **67**, 98; **76**, ii, 447; S. Doc. 42, 35th Cong., 1st sess., pp. 74, 175.

By Board of Engineers, 1857, breakwater, estimate $384,376.50, S. Doc. 42, 35th Cong., 1st sess., pp. 74, 175.

By Maj. Wheeler, extension of eastern pier 288 f., western pier 320 f., and dredging between them to a depth of 12 f., estimate, $52,577.40, **67**, 95, 97. Modified to extend eastern pier 242 f. and western pier 498 f., **69**, 28. Annual dredging, estimate, $10,000, **68**, 32. Sheath piling 1,350 f. and dredging to give a channel 1,350 f. long, 100 f. wide, and 12 f. deep; estimate, $35,422.50, **68**, 112, 115, 117.

By Maj. Houston, dredging channel up to the railroad bridge 1,800 f. long and 200 f. wide; also for general dredging; estimate, $40,000, **70**, 97.

By Board of Engineers, 1870, outer harbor, to consist of, 1st, crib breakwater, parallel with and a portion perpendicular to the shore, in all 1,700 l. f.; 2d, 320 f. of eastern breakwater perpendicular to the shore; 3d, 416 f. of eastern breakwater adjoining the shore; also for the purchase of a dredging outfit and for dredging; estimate, $324,421.40, subsequently increased by Capt. Lydecker to $355,000, **70**, 125; **76**, 449; **77**, 898. Modified by Maj. Houston, to consist of a

## MICHIGAN CITY HARBOR, IND.—Continued.

pile breakwater in place of cribwork, **72**, 130; **75**, 236.

By Board of Engineers, 1875, a breakwater of crib-work 1,400 f. in length; also completion of shore end of the eastern pier of the outer basin; estimate, $163,613.07, subsequently increased by Maj. Gillespie $25,104.04, **75**, 239, 240; **76**, ii, 445. Modified in 1878 to have the cribs rest upon a foundation of bearing piles; estimate completion, $117,000. Approved (see *Boards of Engineers, 1878*). **79**, 1589, 1590.

By Maj. Smith, dredging inner harbor to give a channel 2,700 f. in length, 120 f. in width, and 15 f. in depth; estimate $50,000, **79**, 1593.

In 1880 a Board of Engineers recommended the extension of a pier 400 f. long from the west end of the breakwater, at right angles thereto, and a second pier 300 f. long and 300 f. to the west, the west extension to be connected with the outer end of the existing west pier by fender piling; also the removal of the old east (river) pier to a point 1,100 f. south of the inner face of the breakwater, and the extension of the breakwater eastward to close the opening proposed at the northeast angle of the harbor in 1877, **81**, 2188; **82**, 2263.

The Board of Engineers of 1882 approved Maj. Smith's plan for a masonry and concrete superstructure on the remaining east 166 inner f. to be built in completion of the breakwater; also the plan for an exterior breakwater 2,000 f. in length and covering the entrance to the harbor from northerly and northeasterly gales, with the ultimate removal of about 500 f. of the existing west pier at harbor entrance, **82**, 2264, 2266, 2270.

Between 1880 and 1886, inclusive, $224,375 was appropriated for the outer and $71,875 for the inner harbor, when it was estimated that $395,625 would be required for the completion of the former and $3,125 for the latter, **86**, 317; increased to $8,125 in 1888, **88**, 1921; estimate for completion of outer harbor increased by $24,000 in 1889, **89**, 2200.

A Board of Engineers, 1897, estimated that it would cost $282,150 to improve the harbor, **97**, 2904.

Act of Mar. 3, 1899, provided for carrying on work by continuing contract, and permitted the Secretary of War to modify the project at his discretion. Secretary of War, as recommended by the Board of Engineers of 1897, modified, 1899, the project so as to provide for extending the breakwater pier by 600 f. and constructing a new detached breakwater 1,500 f. long, the existing detached breakwater to be removed; estimated cost of the work, $282,150, **97**, 2903; **1900**, 487. To comply with provision of act authorizing continuous contract, 100 f., on account of price of construction being higher than originally estimated, was deducted from project length of 1,500-f. breakwater (drawings), **1900**, 3875.

**Surveys.**

By Mr. Bowes, 1852, **67**, 100.

By Capt. Mackenzie, **67**, 26, 96. Report, **67**, 97.

Under direction of Maj. Smith, 1878, **79**, 1593.

Minor surveys, **99**, 2896.

MAPS.

Of Michigan City Harbor, **78**, 1188; **79**, 1592.

Sketches of crib for breakwater, **79**, 1588.

**80**, 2006; **81**, 2188; **82**, 2270; **90**, 2666; **96**, 2676; **97**, 2904; (drawings), **1900**, 3878.

## MIDDLE FORK, KY. (See *Kentucky River*.)

## MIDDLE GROUND BAR. (See *Hampton Roads, Va.*)

## MIDDLEPORT, OHIO. (Ice harbor.)

**Commerce.**

Benefit to commerce from ice harbors, **84**, 1708.

**Engineers.**

CHIEF OF ENGINEERS. Report, **84**, 263.

ENGINEER IN CHARGE. Lt. Col. W. E. Merrill. Reports, **84**, 1707, 1708.

ASSISTANT. E. J. Carpenter. Report, **84**, 1709.

**Plans.**

By Col. Merrill, four ice breakers at Middleport; estimate, $9,500; exact location of ice harbors to be left to the discretion of the Chief of Engineers, **84**, 1708, 1710.

**Surveys.**

Ordered by act of Aug. 2, 1882, made under direction of Col. Merrill, **84**, 1708.

## MILE ROCK. (See *San Francisco, Cal.*)

## MILFORD HARBOR, CONN.

**Appropriations.**
1874, $5,000, **74**, 101.
1875, 13,000, **75**, 104.
1878, 10,000, **78**, 52.
1880, 5,000, **80**, 458.
1882, 5,000, **82**, 615.
1888, 5,000, **88**, 550.
1890, 2,500, **91**, 772.
1892, 250, **94**, 652 (allotment).

Total, 45,750

**Commerce.**
Commercial advantages of Milford, **73**, 1042.
Important, **73**, 1042, 1043; **75**, ii, 254, **76**, 225; **78**, 402.
Description of, **1900**, 1358.

**Contracts.**
**1875.** S. F. Shelbourne, dredging 24,232 c. y., 18 cents; contract extended, **75**, ii, 255; **76**, 225; **77**, 213.
**1878.** G. C. Fobes & Co., dredging 2,406 c. y., 28 cents; 12,261 c. y., 10 cents, **79**, 341, 342.
**1880.** J. M. Seward, dredging, 17 cents per c. y., **81**, 600.
**1882.** H. J. Lewis, dredging, 14½ cents per c. y., **83**, 518; **84**, 649.
**1889.** Hartford Dredging Co., dredging, 18 cents per c. y., **89**, 688.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **72**, 85; **73**, 93; **74**, 101; **75**, 104; **76**, 52; **77**, 47; **78**, 52; **79**, 58; **80**, 78; **81**, 92; **82**, 93, 97; **83**, 89; **84**, 95; **85**, 84; **86**, 85, **87**, 48; **88**, 49; **89**, 61; **90**, 55; **91**, 69; **92**, 73; **93**, 78; **94**, 70; **99**, 125; **1900**, 141.
ENGINEERS IN CHARGE:
Maj. G. K. Warren, 1872–74. Reports, **73**, 1041; **74**, ii, 260.
Maj. J. W. Barlow, 1874–83. Reports, **75**, ii, 254; **76**, 225; **77**, 213; **78**, 402; **79**, 341; **80**, 457; **81**, 598; **82**, 614, 632.
Lt. Col. W. McFarland, 1883–86. Reports, **83**, 517; **84**, 648; **85**, 648.
Lt. Col. D. C. Houston, 1886–92. Reports, **86**, 640; **87**, 604; (Col.) **88**, 548; **89**, 685; **90**, 626, 629; **91**, 770; **92**, 677.
Lt. Col. H. M. Robert, 1893–94. Reports, **93**, 929; **94**, 650.
Maj. S. S. Leach, 1900. Reports, **1900**, 1356, 1359.
ASSISTANTS:
J. P. Cotton. Report, **73**, 1043.
S. Dale. Report, **75**, ii, 255.
W. A. Peck. Report, **81**, 600.
H. N. Babcock. Report, **82**, 633.

**Estimates.** (See *Plans* and *Projects.*)
By J. P. Cotton, breakwater, $67,000, **73**, 1043, 1044. Modified by Maj. Barlow to $47,000, **75**, ii, 254; to $55,000, **75**, 104; **76**, 225; to $45,000, **79**, 342. Dredging, $12,500, **73**, 1043, 1044.
By Maj. Barlow, dredging, $3,500, **79**, 342.

**Operations.**
**1874–75.** Twelve jetties built, **75**, ii, 255.
**1875–76.** 18,799 c. y. dredged; long jetty commenced, **76**, 225.
**1876–77.** 5,433 c. y. dredged; long jetty completed except coping, **77**, 213, 214.
**1877–78.** Repairs, **78**, 402.
**1878–79.** 14,667 c. y. dredged; coping placed on long jetty, **79**, 342.
**1879–80.** 47,156 c. y. dredged from channel above and below the long jetty; 250 l. f. of jetty built at Burnes's Point, **80**, 457.
**1880–81.** 27,068 c. y. dredged from vicinity of Town and Merwin wharves, **81**, 598.
**1881–82.** Survey for breakwater off Welch's Point, **82**, 614, 632. Original project completed, **84**, 96; **86**, 641.
**1882–83.** 10,819 c. y. dredged from channel below Merwin's Wharf, **83**, 517.
**1883–84.** 20,049 c. y. dredged from channel below Merwin's Wharf, **84**, 648.
**1888–89.** 18,000 c. y. dredged, **89**, 687.
**1889–90.** 10 t. stone removed from channel and placed upon long jetty; projected improvement practically completed, **90**, 628.
**1890–91.** 170 t. of stone used in repairing 160 l. f. of long jetty, **91**, 772.
**1891–92.** 670 t. granite delivered and placed in repair of long jetty, **92**, 679.
**1893–94.** Repairs made to long jetty, **94**, 652.

**Physical characteristics.**
Formation of bar, **73**, 1042; **74**, ii, 261; **77**, 214.
Site of Milford, Conn., described, **73**, 1042.
Tides, **73**, 1043.
Description of the harbor, **88**, 548; **1900**, 1359.

**Plans.** (See *Estimates* and *Projects.*)
By J. P. Cotton, breakwater at Welch's Point, 890 f. long; dredging channel to a depth of 8 f., **73**, 1044.
By Maj. Barlow, dredging channel up the river, **79**, 342.
By Maj. Barlow, 1882, breakwater from Welch's Point; estimate, $87,000, **82**, 614, 632–634; **85**, 648.

**Private work.**
Attempt of citizens to protect the highway from the undermining action of the waves. by driving rows of piles parallel with the shore, **73**, 1044.

## MILFORD HARBOR, CONN.—Continued.

**Projects.** (See *Estimates* and *Plans.*)

By Maj. Warren, 1872, breakwater about 890 f. long from Welchs Point; protection of bluffs from erosion on east shore of harbor with small jetties; channel 100 f. wide and 4 f. deep across the bar at the mouth of the Wepanwog River; jetty about 650 f. long on the east side of the channel to aid the action of the tide and prevent the dredged area from refilling; estimate, $85,000, **73**, 1043, 1044; **74**, ii, 260; **86**, 640.

The project, except the breakwater, completed in 1881, under aggregate appropriations of $33,000, when Maj. Barlow proposed channel through the bar at the mouth of the river, bay to Merwin's wharf, 100 f. wide and 8 f. deep; estimate, $11,000, **81**, 599; **82**, 614; **84**, 96; **86**, 641; **91**, 771.

$250 was allotted for repair of jetties injured by severe storm, **94**, 652.

Maj. Leach, 1899, estimated it would cost $15,000 for further improvement and $500 annually for maintenance, **1900**, 1362.

**Surveys.**

1872. By J. P. Cotton. Report, **73**, 1043.

Ordered by act of Mar. 3, 1881, for a harbor of refuge, **82**, 97, made under direction of Maj. Barlow, 1882, **82**, 632.

Survey for harbor lines made in 1894 by Lt. Col. Robert, **94**, 653; **95**, 894.

Examination and survey ordered by act of Mar. 3, 1899; examination only made, 1899, by Maj. Leach (report favorable) (see *Projects*), **1900**, 1357, 1359

MAPS. **79**, 342; **82**, 614; **84**, 648; **86**, 640.

## MILFORD HAVEN, VA.

**Appropriations.**

1899, $12,500, **99**, 1431.

**Commerce.**

Small vessels use the place as a harbor of refuge. Annual commerce amounts to about $150,000, **93**, 1321; **95**, 1270.

Description of, **99**, 1430.

**Contracts.**

**1899.** A. M Clegg & Co., dredging, 14¾ cents per c. y. ($5,015) (annulled, 1899), **1900**, 1720.

**1900.** Norfolk Dredging Co., dredging, 24 cents per c. y. ($8,160), **1900**, 1720.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **84**, 177; **93**, 158; **95**, 167; **99**, 216; **1900**, 246.

ENGINEERS IN CHARGE:

Capt. J. Mercur. Report, **84**, 1053.

Maj. C. E. L. B. Davis, 1892–95. Reports, **93**, 1319; **95**, 1267.

Lt. Col. C. J. Allen, 1899–. Reports, **99**, 1429; **1900**, 1719.

**Operations.**

**1899–1900.** 9,825 c. y., dredged, **1900**, 1719.

**Physical characteristics.**

Description of, **93**, 1320; **95**, 1268; **99**, 1429.

**Projects.**

By Maj. Davis, 1895, 10 f. channel, 200 or more f. wide, dredged through bar at entrance to the haven, estimate, $12,500, **95**, 1270; **99**, 1430.

**Surveys.**

Examination ordered by act of Aug. 2, 1882, made under direction of Capt. Mercur (report unfavorable), **84**, 1053.

Examination of the bar at the mouth ordered by act of July 13, 1892, made by Maj. Davis, 1892 (report favorable), **93**, 1319.

Survey ordered by act of Aug. 17, 1894, made by Maj. Davis, 1895 (report favorable) (see *Projects*), **95**, 1268.

Examination made, 1899, by Lt. Col. Allen, **99**, 1430.

## MILL BOTTOM, KY. (See *Ohio River.*)

## MILLBRIDGE, ME. (See *Narraguagus River.*)

## MILL CREEK, OHIO. (See *Ohio River.*)

## MILLE LACS LAKE, MINN. (See *Mississippi River.*)

## MILL RIVER, CONN. (See *New Haven Harbor; Southport Harbor; Stamford Harbor.*)

## MILTON HARBOR, N. Y.

**Commerce.**
Unimportant, **95**, 868.

**Engineers.**
CHIEF OF ENGINEERS. Report, **95**, 94.
ENGINEER IN CHARGE. Lt. Col. H. M. Robert, 1895. Report, **95**, 867.
ASSISTANT. Lt. W. E. Craighill. Report, **95**, 868.

**Physical characteristics.**
Description of, **95**, 868.

**Surveys.**
Examination ordered by act of Aug. 17, 1894, made under the direction of Lt. Col. Robert, 1894 (report favorable), **95**, 868.

## MILWAUKEE AND ROCK RIVER CANAL, WIS. (See *Rock River, Wis. and Ill.*)

**Appropriations.**
July 1, 1864, $325,276.83.[a]

## MILWAUKEE BAY, WIS.—(Harbor of refuge.)

**Appropriations.**

| | | |
|---|---|---|
| 1881, | $100,000.00, | **81**, 2115. |
| 1882, | 100,000.00, | **82**, 2156. |
| 1884, | 85,000.00, | **84**, 1864. |
| 1886, | 60,000.00, | **86**, 1680. |
| 1888, | 70,000.00, | **88**, 1860. |
| 1890, | 80,000.00, | **90**, 2353. |
| 1892, | 75,000.00, | **92**, 2200. |
| 1894, | 45,000.00, | **95**, 2639. |
| 1896, | 20,000.00, | **96**, 2505. |
| 1897, | 168,737.91, | **97**, 2690. |
| 1899, | 50,000.00, | **99**, 2769. |
| 1900, | 105,650.00, | **1900**, 3696. |
| Total, | 959,387.91 | |

**Commerce.**
Extent of commerce to be benefited by improvement, and necessity for harbor of refuge, **81**, 2119.

**Contracts.**
**1881.** J. W. Dennis, crib construction, **81**, 2115.
**1882.** C. H. Starke, crib construction, **83**, 1704.
**1884.** C. H. Starke, crib construction, **85**, 2017.
**1886.** H. B. Herr, crib construction, **87**, 2056.
**1888.** C. H. Starke, 400 l. f. breakwater construction, $43,992.28, **89**, 2069.
**1890.** C. H. Starke, 400 l. f. of breakwater extension and superstructure, $52,711, **91**, 2559.
**1892.** D. A. McLeod, breakwater extenson and superstructure construction, $65,951.51. Supplementary contract made increasing amount of proposed work. **93**, 2742, 2744.
**1894.** H. B. Herr & Co., 400 l. f. pier extension—timber, stone, etc.—$29,738, **95**, 2639. Actual cost, $96.75, per l. f. **96**, 2503.
**1897.** Knapp and Gillen, building 1,600 l. f. breakwater extension—timber, stone, etc.—$149,770, **97**, 2691.
**1899.** R. B. Rice, breakwater extension—lumber, stone, ironwork—$135,135, **99**, 2770.

**Engineers.**
CHIEF OF ENGINEERS. Reports, **80**, 210; **81**, 280, 2120; **82**, 275; **83**, 284; **84**, 284; **85**, 307; **86**, 301; **87**, 266; **88**, 242; **89**, 281; **90**, 254; **91**, 325; **92**, 311; **93**, 353; **94**, 325; **95**, 363; **96**, 318; **97**, 402; **98**, 393; **99**, 466; **1900**, 531.
BOARD OF ENGINEERS. Convened at Milwaukee, Wis., Apr. 20, 1881, by S. O No. 2, C. of E., to report upon project for harbor of refuge, Milwaukee Bay, **81**, 2122. (Majs. Comstock, Weitzel, and Robert.)
ENGINEERS IN CHARGE:
Lt. Col. D. C. Houston, 1880–84. Reports, **81**, 2113, 2123; **82**, 2155; **83**, 1703.
Capt. W. L. Marshall, 1884–89. Reports, **84**, 1863; **85**, 2015; **86**, 1679; **87**, 2055, 2060; **88**, 1859.
Maj. C. E. L. B. Davis, 1889–92. Reports, **89**, 2067; **90**, 2351; **91**, 2553.
Maj. J. F. Gregory, 1892–94. Reports, **92**, 2199; **93**, 2741; **94**, 2081.
Capt. C. F. Palfrey, 1895. Report, **95**, 2637.
Capt. G. A. Zinn, 1896–98. Reports, **96**, 2502; **97**, 2689; **98**, 2324.
Capt. J. G. Warren, 1899–. Reports, **99**, 2767; **1900**, 3695.
ASSISTANTS:
W. H. Hearding. Reports, **81**, 2114; **82**, 2156; **83**, 1704; **84**, 1864; **85**, 2017; **87**, 2058; **88**, 1861.
Lt. C. H. McKinstry. Report, **94**, 2083.
C. Crossman. Report, **96**, 2505.

**Operations.**
**1881–82.** 800 l. f. crib-work built and sunk in construction of north arm of breakwater, **82**, 2157.
**1882–83.** 200 l. f. crib-work sunk, completing J. W. Dennis's contract for 1,600 l. f. substructure; 550 l. f. crib substructure sunk under Starke's contract, **83**, 1705.
**1883–84.** 300 l. f. crib work sunk in extension of north arm of breakwater and 850 l. f. superstructure built, **84**, 1864.
**1884–85.** 600 l. f. crib-work built

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[a] Of this amount $76,492.77 was paid to the canal company and $148,784.06 was paid to the State of Wisconsin, which aided the building of the canal. (Treasury Doc. 373, 1882.)

## MILWAUKEE BAY, WIS.—Continued.

and placed in extension of breakwater, **85**, 2017.

**1885-86.** One crib placed in extension of breakwater; 1,600 l. f. superstructure built, **86**, 1679.

**1886-87.** Five cribs placed upon stone foundation in extension of east breakwater, **87**, 2056. Injury to breakwater from ice, **87**, 2056, 2058.

**1887-88.** 100 l. f. substructure and 400 l. f. superstructure completed, **88**, 1860.

**1888-89.** 50 l. f. breakwater extension built under contract, **89**, 2068.

**1889-90.** Main arm of breakwater extended 200 f.; also 225 l. f. superstructure built, **90**, 2351.

**1890-91.** Repair and extension of breakwater, **91**, 2554.

**1891-92.** 525 l. f. breakwater extension completed, **92**, 2199.

**1892-93.** Breakwater extension, superstructure construction, and renewal in progress, **93**, 2742.

**1893-94.** Cribs overturned by storm of previous year replaced; 400 l. f. new superstructure built; 1,500 l. f. old superstructure repaired and strengthened; and outer arm of breakwater strengthened, **94**, 2082.

**1894-95.** Construction of cribs in progress, **95**, 2638.

**1895-96.** In connection with previous year, 4 cribs constructed, aggregating 400 l. f. Decking of north arm repaired, **96**, 2503.

**1896-97.** Breakwater extension in progress, and shore arm of breakwater repaired, **97**, 2689, 2690.

**1897-98.** In connection with previous year, 15 cribs, each 100 f. long, built in extension of breakwater in progress. Repairs made to breakwater. **98**, 2324.

**1898-99.** 1,700 f. of crib breakwater extension in progress last year completed; minor repairs made to works; preparation made for construction of substructure and superstructure to complete existing project; schooner engaged for part of year as temporary light-house, **99**, 2767.

**1899-1900.** Breakwater construction in progress (photographs); minor repairs made to works, **1900**, 3695.

**Physical characteristics.**

Shore accretions, **93**, 2743; **94**, 2082; **95**, 2638; **96**, 2503.

Anchorage area, **93**, 2743.

Storms damaging works, **93**, 2742; **94**, 2082; **99**, 2768.

**Projects.**

By Col. Houston, 1880, harbor of refuge in Milwaukee Bay by an artificial harbor inclosing a part of Lake Michigan within an outer breakwater of crib work upon a random stone foundation, estimate, $800,000, **81**, 2117, 2119, 2121. Recommendations of Board of Engineers, **81**, 2121, 2122.

Plan of Capt. Marshall for a concrete superstructure faced with cast iron, **87**, 2060. Approved for trial by Board of Engineers, **87**, 2061.

In 1889 it was recommended that the execution of the concrete superstructure be suspended, and that the works be continued according to the plan previously followed. Approved. **89**, 2068.

In 1895-96 Capt. Zinn estimated it would cost $155,650 to complete the existing project, the extra cost being due to the maintenance of a light-ship at the end of the breakwater and to repair of the works where damaged by storms during the construction of the whole work, **96**, 2504; **97**, 2690; **98**, 2325.

Renewal of superstructure of breakwater with concrete instead of timber recommended, 1899, **99**, 2769.

**Surveys.**

Ordered by act of June 14, 1880, made, 1880, under direction of Maj. Houston, **81**, 2116.

MAPS. **83**, 1704; **84**, 1864; **85**, 2016; **97**, 2690; **99**, 2768 (photographs). (See *Operations, 1900.*)

## MILWAUKEE HARBOR, WIS.[a] (See *South Milwaukee Harbor, Wis.*)

**Appropriations.**

| | | |
|---|---|---|
| 1836 | $400.00 (survey), act July 4. | |
| 1843 | 30,000.00 | 66, iii, 35; 76, ii, 386. |
| 1844 | 20,000.00 | |
| 1852 | 15,000.00 | |
| 1853 | 163.94 | 66, iii, 35. |
| 1864 | 15,000.00 | |
| 1866 | 48,283.51 | |
| 1869 | 35,640.00 (allotted), **69**, 22. | |
| 1870 | 40,000.00, **70**, 36. | |
| 1871 | 38,000.00, **71**, 34. | |
| 1873 | 10,000.00, **73**, 34. | |
| 1874 | 10,000.00, **74**, 40. | |
| 1875 | 25,000.00, **75**, 44. | |
| 1876 | 26,000.00, **76**, 36, 97. | |

**Appropriations**—Continued.

| | |
|---|---|
| 1878 | 15,000.00, **78**, 116. |
| 1879 | 7,500.00, **79**, 155. |
| 1880 | 10,000.00, **80**, 1935. |
| 1881 | 8,000.00, **81**, 2125. |
| 1882 | 10,000.00, **82**, 2158. |
| 1888 | 10,000.00, **88**, 1863. |
| 1890 | 6,100.00, act Mar. 17.<br>6,000.00, **90**, 2355. |
| 1892 | 14,000.00, **92**, 2202. |
| 1894 | 7,000.00, **95**, 2643. |
| 1896 | 7,000.00, **96**, 2507. |
| 1899 | 26,000.00, **99**, 2772. |
| Total, | 440,087.45 |

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[a] Surveys—Reports: Feb. 4, 1837, estimate $92,183.54; May 28, 1843; Aug. 2, 1864, estimate $15,000. (H. Doc. No. 482, 55th Cong., 2d sess.)

**MILWAUKEE HARBOR, WIS.**—Continued.

**Commerce.**
Commercial importance of Milwaukee, 66, iv, 126; 67, 78, 79; 68, 103; 73, 209; 74, 150; 79, 1525.
Early improvement consisted of bridge piers, 76, ii, 385.
Harbor of refuge, importance as, 66, iv, 126; 67, 78; 73, 209.
Railroads and shipping, 66, iv, 126; 77, 870.
Benefit of improvement, 80, 1935.
Increasing, 95, 2641.

**Contracts.**
**1867.** V. Kuhlman, materials, 67, 57; 76, ii, 388.
**1868.** C. H. Starke, materials and labor, 76, ii, 388. E. W. Diercks, materials, 76, ii, 388.
**1870.** Hasbrouck & Conro, materials and labor, 71, 34, 115.
**1871.** H. Starke, materials and labor, 71, 115; 72, 124.
**1873.** A. Conro, dredging, 73, 209
**1874.** A. Conro, dredging, 28¼ cents per c. y., 75, 211.
**1875.** A. Conro, dredging, materials and labor, 75, 212.
**1879.** Stark, Smith & Co., dredging, 19¾ cents per c. y., 80, 1935.
**1880.** Stark, Smith & Co., dredging, 23 cents per c. y., 81, 2125.
**1881.** Stark & Smith, pile protection, superstructure, and repairs, 81, 2125.
**1886.** H. B. Herr & Co, superstructure reconstruction, 87, 2062.
**1889.** W. T. Casgrain, reconstruction of 400 l. f. of superstructure, $7,263.20, 89, 2074.
**1890.** C. H. Starke, dredging, 25 cents per c. y., 90, 2354.
**1891.** C. H. Starke, dredging, 18 cents per c. y., 92, 2202.
**1892.** C. H. Starke, building superstructure and repairing piers, timber, etc., $10,049.10, 93, 2746.
**1894.** Wisconsin Dredge & Dock Co., dredging, 11.8 cents per c. y. ($5,000), 95, 2644.
**1896.** W. A. Starke, dredging, 14¼ cents per c. y. ($1,740), 97, 2694.
**1899.** A. F. Bues, dredging, 14.4 cents per c. y. ($14,400), 99, 2773.

**Documents.** (Not published in reports.)
S. Ex. Doc. 16, 34th Cong., 3d sess

**Engineers.**
CHIEF OF ENGINEERS. Reports, 66, 5, iii, 12; 67, 22; 68, 30; 69, 26; 70, 35; 71, 34; 72, 33; 73, 34; 74, 40; 75, 44; 76, 97, ii, 386; 77, 101; 78, 116; 79 155; 80, 207, 210; 81, 280; 82, 276; 83, 284; 84, 285; 85, 308; 86, 302; 87, 267; 88, 243; 89, 282; 90, 254; 91, 325; 92, 311; 93, 354; 94, 326; 95, 363; 96, 319; 97, 403, 408; 98, 394; 99, 467; 1900, 532, 539.
BOARD OF ENGINEERS. Directed (1854) to revise plan for improvement of harbor, 76, ii, 386.
ENGINEERS IN CHARGE:
Lt. Col. J. Kearney, 1854; 76; ii, 386.
Maj. J. D. Graham, 1856–64. Report, S. Ex. Doc. 42, 35th Cong., 1st sess, p. 63.
Lt. Col. T. J. Cram, 1864. Report, 66, 17.
Maj. J. B. Wheeler, 1866-69. Reports, 66, iv, 126; 67, 78; 68, 103.
Maj. D. C. Houston, 1870–84. Reports, 70, 94; 71, 115; 72, 124; 73, 208; 74, 150; 75, 211; 76, ii, 385; 77, 869; 78, 1165; 79, 1523; (Lt. Col.), 80, 1933; 81, 2124; 82, 2158; 83, 1705.
Capt. W. L. Marshall. 1884-89. Reports, 84, 1866; 85, 2018; 86, 1680; 87, 2061; 88, 1862.
Maj. C. E. L. B. Davis, 1889-92. Reports, 89, 2072; 90, 2353; 91, 2560.
Maj. J. F. Gregory, 1892–94. Reports, 92, 2201; 93, 2744; 94, 2091.
Capt. C. F. Palfrey, 1895. Report, 95, 2640.
Capt. G. A. Zinn, 1896–98. Reports, 96, 2506; 97, 2692, 2765; 98, 2325.
Capt. J. G. Warren, 1899–. Reports, 99, 2770; 1900, 3697.
ASSISTANTS:
H. W. Gunnison. Report, S. Ex. Doc. 42, 35th Cong., 1st sess., p. 66.
Capt. D. P. Heap. 67, 78.
Wm. H. Hearding. Reports, 68, 103; 72, 124; 73, 208; 74, 150; 77, 876; 78, 1166; 79, 1524; 80, 1934; 81, 2124; 82, 2158; 83, 1706; 84, 1866; 85, 2019; 87, 2063; 88, 1863.
J. A. B. Tomkins. Report, 95, 2642.

**Expenditures.**
In repairs, 1864–65, $2,171.27, 66, 18
Total cost, 1854, of pier extension 600 f to each pier, and of repairing damages caused by collisions, $161,923.17, 74, 152.

**Financial statements.**
Relative to the work of Messrs. Hasbrouck & Conro, contractors with the city of Milwaukee, 76, ii, 387.

**Legal proceedings.**
Limits defined for lawful deposit of dredged or other material in Lake Michigan in vicinity of Milwaukee approved by Secretary of War, 1899, 99, 2771.

**Legislation.**
City empowered by Wisconsin to levy a tax on city property for harbor improvement, 76, ii, 386.

**Operations.**
**1845** or **1846.** Piers to 10 f. of water; dredging at old river mouth, 76, ii, 385.
NORTH CUT.
**1854-58.** 1,388 l. f. north pier crib

## MILWAUKEE HARBOR, WIS.—Continued.

built; 1,296 l. f. south pier crib built; 75,966 c. y. dredged (by the city of Milwaukee and the U. S. Government). (See *Private and corporate work.*) S. Ex. Doc. 42, 35th Cong., 1st sess., pp. 63–65, **76**, ii, 386, 387.

**1864-65.** Repairs to piers; sand-tight filling, 66, 18.

**1866-67.** Refilling cribs, **67**, 22, 78, 80.

**1867-68.** Refilling cribs, **68**, 104.

**1868-69.** 200 l. f. north pier crib built; 100 l. f. south pier crib built; dredging in channel, **69**, 26; **76**, ii, 388.

**1869-70.** 50 l. f. north pier crib built; 150 l. f. south pier crib built; slight repairs, **70**, 35, 36, 94; **76**, ii, 388.

**1870-71.** Slight repairs, 71, 34, 115.

**1871-72.** 350 l. f. north pier crib built; 300 l. f. north pier superstructure built; 350 l. f. south pier crib built; slight repairs, **72**, 33, 124; **76**, 389.

**1872-73.** 160 l. f. north pier superstructure built; 400 l. f. south pier superstructure built; guard piles driven; repairs to pier heads and superstructure, **73**, 34, 208; **76**, ii, 389.

**1873-74.** Dredging between piers, **74**, 40, 150.

**1874-75.** 29,825 c.y. dredged; dredging between piers; repairs, **75**, 44, 211.

**1875-76.** 400 l. f. north pier superstructure built (masonry); pier heads built, **76**, 97, ii, 385.

**1876-77.** 160 l. f. north pier superstructure built (masonry); 800 l. f. south pier superstructure built; 560 l. f. pile and timber protection, **77**, 101, 869.

**1877-78.** 98 l. f. north pier superstructure built (masonry); 331 l. f. south pier superstructure built; 260 l. f. pile protection; repairs, **78**, 116, 1166.

**1878-79.** 393 l. f. north pier superstructure built (masonry), **79**, 155, 1524.

**1879-80.** 30,000 c. y. dredged, **80**, 1934.

**1880-81.** 24,917 c. y. dredged, **81**, 2124.

**1881-82.** Pile protection driven along 1,131 l. f. of inner pier section; repairs to pile protection and superstructure, **82**, 2158, 2159.

**1883-84.** Repairs to piers, **84**, 1866.

**1886-87.** 270 l. f. of north pier superstructure rebuilt, **87**, 2062.

**1887-88.** 336 l. f. of superstructure rebuilt, **88**, 1863.

**1888-89.** 340 l. f. of outer section of south pier rebuilt, **89**, 2073.

**1889-90.** 60 l. f. of north pier superstructure built; 22,224 c. y. dredged, **90**, 2354.

**1891-92.** 25,896 c. y. dredged from the channel between the piers; repairs to north pier, **92**, 2201.

**1892-93.** 200 l. f. superstructure of south pier renewed, north and south piers repaired, and piles driven for protection of north pier, **93**, 2745.

**1894-95.** 33,414 c. y. dredged and minor repairs made, **95**, 2641.

**1896-97.** 14,272 c. y. dredged and 407 l. f. south pier rebuilt, **97**, 2692.

**1898-99.** Piers repaired; 53,381 c. y. dredged; some old piling removed, **99**, 2771.

**1899-1900.** 28,801 c. y. dredged; minor repairs to south pier, **1900**, 3698.

**Physical characteristics.**

General characteristics of Milwaukee River and tributaries, **76**, ii, 385; **95**, 2642; **97**, 2765.

Character of material dredged in North Cut, S. Ex. Doc. 42, 35th Cong., 1st sess., pp. 70, 71.

Encroachment on the entrance, 1867, by a bar from the northward, **67**, 22; which became so formidable in 1869 that extension of the piers was necessitated, **68**, 30; **76**, ii, 388.

Effect of river freshets, **76**, ii, 385.

Shoaling of entrance, **79**, 1524.

The channel maintained with less dredging than at many other harbors on Lake Michigan, **93**, 2745; **94**, 2092.

Water-level observations, **96**, 2506; **97**, 2692; **98**, 2326.

The harbor assumed to be the artificial channel, together with the parts built for its protection, extending from deep water in Lake Michigan to deep water in Milwaukee River, to which the artificial channel gives entrance, **97**, 2765.

**Plans.** (See *Projects.*)

By Lts. Center and Rose, 1836, improving the entrance to the harbor by opening the "North or Straight Cut" at a point about 3,000 f. north of the natural mouth of the river, **76**, ii, 385, 387; **79**, 1523.

By Maj. Graham, 1857, repairs to piers and dredging at old entrance of harbor; estimate, $48,283; withdrawn with the consent of the Chief of Engineers, **66**, 5, iv, 126.

**Private (city) work.**

$50,000 raised, 1855, by taxation of property in the city of Milwaukee and placed at the disposal of the United States, to be expended for local harbor improvement in conjunction with $15,000 appropriated in 1852 by Congress, **76**, ii, 386, 387.

Harbor built mainly by the city authorities, 1854–57, **69**, 26.

Expenditures by the city from 1855–70, $445,971.20, **76**, ii, 387; **79**, 1523.

**Projects.** (See *Plans; Private (city) work.*)

By Maj. Graham, 1856, dredging through the Straight Cut (defined by parallel piers 260 f. apart and extending to 12 f. depth of water), **76**, ii, 386. S. Ex. Doc. 42, 35th Cong., 1st sess., p. 63.

By Col. Cram, 1865, rendering the piers

**MILWAUKEE HARBOR, WIS.**—Continued.

sand tight by brush, slab, and stone filling; estimate, $3,750. **66**, 18.

By Maj. Wheeler, 1867, extension of the piers each 300 f.; estimate, $65,872.82, **67**, 22, 29; **74**, 151.

By Maj. Wheeler, 1868, to extend the piers 400 f. or to 15 f. depth of water; estimate, $80,000, **68**, 30; **69**, 27.

By Maj. Houston, 1874, cut-stone superstructure on 2,240 l. f. of pier; estimate, $300,000, **74**, 40, 151.

Foregoing modified, 1875, for dry masonry; estimate, $120,000, **75**, 211; **76**. ii, 385. Owing to limited appropriations stone superstructure was limited to the north pier and a superstructure of wood built on the south pier, **77**, 869.

In 1874 a stone superstructure for a part of the north pier was adopted, **74**, 151; **75**, 211; **77**, 869. Since that date the project completed by channel 18 f. deep with an aggregate of appropriations from 1852 to 1882 of $313,587.45, and expenditures of the city amounting to $321,355.66, **82**, 276.

In 1889 Maj. Davis estimated $20,000 as the amount required to rebuild the south pier superstructure and to repair the north pier, **89**, 2073.

By Capt. Zinn, 1896, for 21-f. channel, with minimum width between piers of 200 f., and width outside pierheads of 600 f.; estimate, $12,000, and about $3,000 annually for maintenance, **97**, 2767; **99**, 2770.

Capt. Warren recommended, 1899, that the entire superstructure of the north pier, because of the disintegration of the concrete (photographs), be rebuilt of concrete monoliths, **99**, 2772.

**Surveys.**

By Lts. Center and Rose, 1836, **76**, ii, 385.

1864. **66**, 17.

Soundings, 1867. **68**, 103; **76**, ii, 388.

Soundings, 1873. **76**, ii, 390.

Soundings between harbor piers, **83**, 1706.

Survey with a view to obtaining a depth of 21 f. ordered by act of June 3, 1896, made in the same year by Capt. Zinn (see *Projects*), **97**, 2765.

Examination for necessary enlargement and satisfactory protection of harbor ordered by act of June 6, 1900, **1900**, 3698.

MAPS. **66**, i; **84**, 1866; **93**, 2746; **95**, 2644. (Photographs. See *Projects*, 1899.)

**MINGO CREEK, S. C.**

**Appropriations.**

1888, $5,000, **88**, 130.
1890, 5,000, **90**, 1201.
1892, 3,000, **92**, 1209.
1894, 4,000, **95**, 1406.

Total, 17,000

**Commerce.**

Description of, **93**, 1482; **94**, 1083; **95**, 1407; **96**, 1165.

In 1892–93 the freight moved on the river amounted to 94,665 t., **93**, 1481; in 1893-94, 114,375 t., **94**, 1082; in 1894–95, 136,957 t., **95**, 1406; in 1895–96, 169,125 t., **96**, 1164.

**Engineers.**

CHIEF OF ENGINEERS. Reports, **87**, 139; **88**, 130; **89**, 150; **90**, 135; **91**, 173; **92**, 171; **93**, 186; **94**, 170; **95**, 194; **96**, 173; **97**, 217.

ENGINEERS IN CHARGE:

Capt. W. H. Bixby, 1887. Reports, **87**, 1106, 1108.

Capt. F. V. Abbot, 1888–97. Reports, **89**, 1161; **90**, 1200; **91**, 1455; **92**, 1208; **93**, 1480; **94**, 1081; **95**, 1405; **96**, 1163; **97**, 1450.

ASSISTANT. R. Whitford. Reports, **89**, 1162; **90**, 1201; **91**, 1456; **92**, 1209; **93**, 1481; **94**, 1082; **95**, 1406; **96**, 1164; **97**, 1452.

**Operations.**

**1888-89.** 300 logs, snags, and trees removed from channel, and 1,306 trees and 429 cords of brush cut from the banks, **89**, 1162.

**1889-90.** 424 logs and snags and 22 cords small snags removed from channel, and 1,309 trees and 796 cords brush cut from banks, **90**, 1201.

**1890-91.** 1,042 snags and logs removed from the channel, and 2,412 trees and 444 cords of brush cleared from the banks, **91**, 1456.

**1891-92.** 422 snags and logs removed from the channel, and 2,632 trees and 378 cords of brush cleared from the banks, **92**, 1210.

**1892-93.** About 900 snags and other obstructions removed from the channel and banks, **93**, 1481.

**1893-94.** About 40 snags and other obstructions removed, **94**, 1082.

**1894-95.** About 200 snags and other obstructions removed, **95**, 1407.

**1896-97.** About 300 snags and other obstructions removed, **97**, 1452.

**Physical characteristics.**

Description of, **87**, 1106; **89**, 1162, 1163.

**Projects.**

By Capt. Bixby, 1887, steamboat navigation, mouth to Williams Landing, 21 miles; pole boats, at high water up to the head of navigation, by removal of snags, logs, trees, and similar obstructions; estimate, $17,000, **87**, 1108; **89**, 1161; **92**, 1208.

**Surveys.**

Ordered by act of Aug. 5, 1886, made, 1887, under direction of Capt. Bixby, **87**, 1108.

MAPS. **90**, 1202.

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